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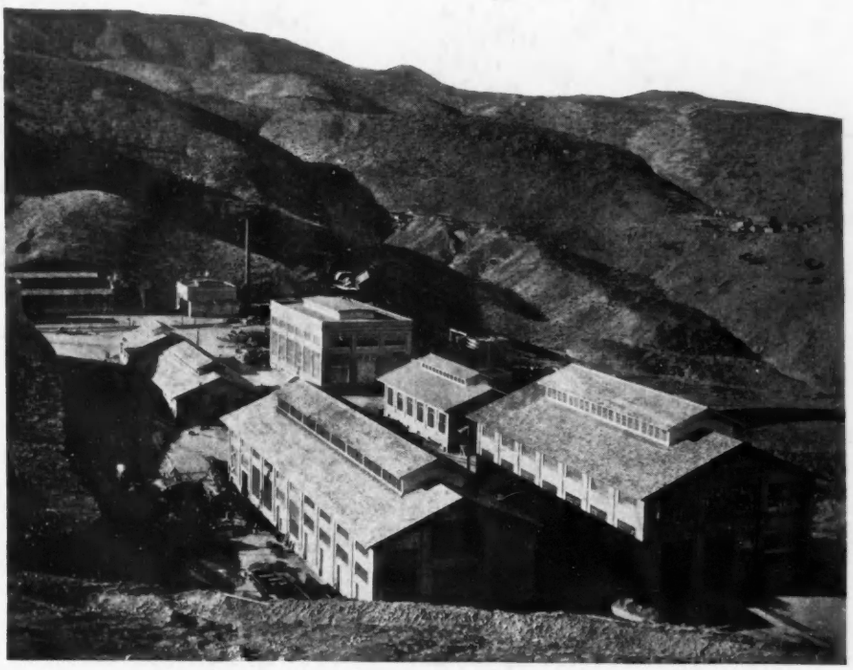
Twenty-five Cents Per Copy

November 3, 1923

Electrical World



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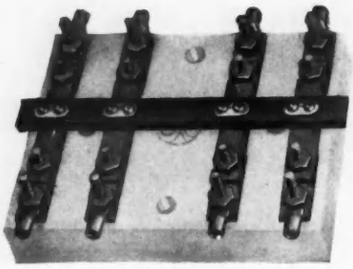

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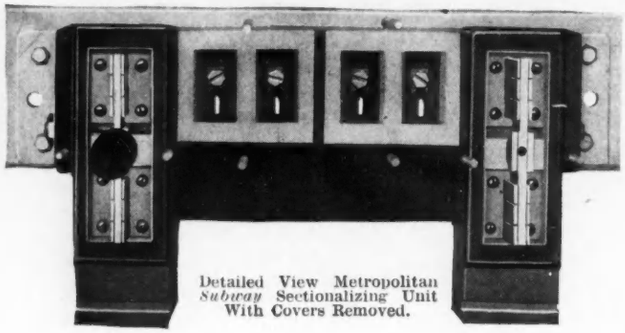

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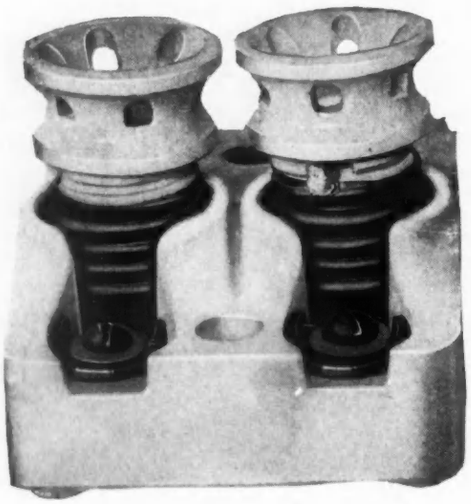

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Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

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W. H. ONKEN, JR. Editor — HAROLD V. BOZELL Editor

Volume 82 — New York, Saturday, November 3, 1923 — *Number* 18

Charles Proteus Steinmetz

AN ABLE engineer, a wonderful analyst, a brilliant scientist and philosopher has been lost to the world through the death of Dr. Steinmetz. When Steinmetz spoke, men's faces lighted in anticipation and glowed with appreciation at the breadth, depth and clearness of his thoughts, fluently expressed and illumined by a personality sympathetic, mellowed and ripened by a life of study and experience. Those qualities which fix the moral stature of a man—patience, kindness, generosity, courtesy, humility, unselfishness, good temper, sincerity—were possessed in large measure by Charles Proteus Steinmetz. That he was not a genius he himself was the first to admit. The mystic fire which flamed out of Edison, Tesla, Bell and others was not in Steinmetz. But what he did have was a thorough knowledge of fundamentals and a firm conviction which even those who did not agree with him admired. He was not free from error or misjudgment, no man is; but he was intensely human and likable, and his life, instead of being soured and thwarted by his physical handicap, was one of sacrifice, service and devotion to his fellow men. In this his socialism was ideal.

His career was crowned with brilliant success earned by unremitting effort; his contributions to the electrical art were of incalculable value; his sympathy encouraged and helped many, and his constructive, broad and friendly outlook on life was an inspiration and gripped the public as firmly as it did his fellow engineers.

The nation and the electrical industry have lost a great man—a man whose life and accomplishments will not be soon forgotten either in the electrical ranks, where he was so prominent a figure, or in the wider circles to which his public spirit, his optimism and his exemplification of how the mind of man can triumph over the body had carried cheer and courage.

Robert Sever Hale

An engineer whose exceptional analytical ability, unusual powers of co-ordination and untiring service to the industry have exercised a profound influence on electrical standardization

FORTUNATE is the man who has enjoyed a freedom from routine that has enabled him to assume a definite responsibility in discovering the less obvious factors, relationships and possibilities bound up with electrical problems. Such has been the career of R. S. Hale, marked by indefatigable and intensive work throughout an immense range of activity. As superintendent of special research for the Edison Electric Illuminating Company of Boston, Mr. Hale holds a post of unique opportunities among utility officials, and from this base he has served the entire industry through his ardent championship of standardized wiring for safety, good appearance and low cost, accompanied by a corresponding standardization of connections from service to wiring and from wiring to appliances. As chairman for years of the wiring committee of the N. E. L. A. and an active participant in association activities generally, and rate research in particular, his voice and pen have been the mediums of inspiring leadership and constructive service.

Recent standardization progress in plugs and receptacles, acceptance of the solid neutral and reductions in required fusing through simplified wiring, together with authorized increased current ratings of branch circuit fuses and the abolition of the so-called 660-watt rule, have followed a long period of persistent effort on the part of Mr. Hale and like-minded associates in the electrical industry who have grasped the economic value of uniform methods of utilizing electric service.

This many-sided engineer was born in Boston on Oct. 3, 1869. He was educated at Harvard and Cornell, receiving the latter's degree of M.E. in 1893. Until 1895 he was employed by the Boston Edison company, when he engaged in steam engineering practice with special interest in boiler insurance. From 1897 to 1904 he was a member of the engineering firm of Hale & Codman, Boston, then returning to the Edison company as assistant to the general superintendent and afterward superintendent of the sales department, from which post he passed to the research activities which have for some years so closely occupied him.

Mr. Hale's advisory suggestions on the ever-present question of rates have been a feature of Boston Edison and N. E. L. A. affairs for many years, and he was a pioneer in recognizing the place of demand schedules in American central-station practice. He has written many noteworthy articles upon engineering and public utility economics.

Editorial Comment

Electrical World, November 3, 1923

Volume 82 Number 18

Interconnection and Its Public Benefits

INTERPLANT tie lines are of great benefit to the electric light and power industry. This is freely admitted by the executives and operators of systems already interconnected and would be as freely acknowledged by the users of the service were they apprised of the circumstances. To impart this information is the duty of the electric light and power company. What if there are some in the community who already appreciate the benefits of tie lines? Are these so patent as not to need frequent reiteration, or is the industry's larder of good will so overstocked as to make its replenishment superfluous? The public welfare is generally well served by a carefully planned interconnection, economically justified, and the credit for such work should go to the utility having the foresight to undertake it. Normally people think there is not much public service worthy of praise, and how can they think otherwise if the utility manifests no pride in its accomplishments? The next best thing to doing a thing worth while is to let people know about it. Ears attuned to complaints need a little relaxation, and there is nothing more refreshing to a harassed operator than praise from a patron.

Enough Bee Loads Will Electrify America

IT IS an encouraging thing that central-station men are beginning to talk more these days about the essential nature of better co-ordination, better harmony between the various elements in the local electrical family. For if the job of getting all the homes, stores, offices and factories in any city adequately wired and equipped is to be carried forward, if electrical men are going to keep up with the cumulative growth of their market, they must develop and apply a more united effort than has been seen so far. Selling policies must be adjusted, destructive competition must be transformed and raised to the creative plane, and dealers, contractors and central-station men must organize their common purpose into a co-operative program that will actually make some progress with this task of electrifying America that is talked about so much. Actually, there is no reason why this job cannot be done with some show of speed.

F. M. Feiker tells a story of some bees on a farm up in New York State. Six tons of honey had been stored and locked in on the upper floor of a barn. But when the owners came for it less than one-half of it remained, and they discovered that bees had found an entrance through a hole beside a window and had carried off three tons in countless tiny bee loads. Organization and consistent work had done it, just as intelligent co-ordinated effort will carry to attainment this vision of the completely electrified community. But the work of it can only be carried out locally, and it will not be done until dissension between local electrical men has been reasoned away and the power of them all is organized into practical co-operation for progress. Those bees would never have moved three tons of honey had any part of their time been spent in stinging one another.

When to Stop Specifying and Start Advising

WHEN any radically new equipment has to be developed to meet an operating need the prospective users of that equipment, especially if they have broad experience in operation, are in a better position than manufacturers to specify the principal features of design which should be incorporated in the new equipment. Even then any broad-minded user will recognize that the specifications should be developed in close consultation with manufacturers in order to obtain a product which is practical and economical. Until experience with the new equipment is widely disseminated it is also readily conceivable that such operators are in the best position to specify how that equipment shall be modified to meet their operating requirements most satisfactorily. However, as time goes on and experience is gained, the manufacturer who keeps in touch with his various clients is in a more favorable position than any one of the users of his equipment to ascertain the relative merits and disadvantages of different designs for the purpose considered. Especially is this true if the manufacturer maintains close contact by studying the operating company's requirements and by voluntarily welcoming all suggestions which will help him to improve his equipment.

The time is therefore reached when it is technically unnecessary and economically undesirable for a user to specify special designs every time he has occasion to apply equipment, although he should continue to advise manufacturers of his needs. The demand for special equipment increases the manufacturer's overhead and operating expense because a larger engineering staff must be maintained owing to the special manufacturing procedure which the manufacturer is forced to establish. As a result the cost of manufacturing special equipment is considerably more than that of standard equipment for the same purpose, delays in delivery occur, and a serious burden is placed upon the user's system should hurried replacement be necessary. Not only does the purchaser of special equipment have to pay a higher price than he does for standard equipment, but he increases the price of standard equipment because of the overhead expenses, which

are in most cases spread to a great extent over both the standard and special equipment. The user of special equipment is not only penalizing himself but every one else in the industry. How much better it would be for all concerned, and particularly the purchaser, if more attention were given to how standard equipment can be applied to particular jobs than to what changes in existing designs are considered necessary.

In another part of this issue H. W. Young points out how seriously the ordering of special equipment has reacted on the purchaser and how he will benefit if standard products are used more extensively. Prices will become lower, deliveries will become more prompt, and replacement of broken parts or entire equipments will be decidedly facilitated.

Of course, if manufacturers have not kept pace with the demands for improvement from the operating field, it is their own fault that so much special equipment is required and it is the misfortune of users that they must stand the expense of this uneconomical practice. Where this is the case, operating companies will find it advantageous to decide among themselves and through technical committees of the national association upon what the desirable characteristics of the equipment under consideration are. These requirements, if discussed with the manufacturers' national associations, should lead to a situation where less special equipment will have to be demanded and where advantage can be taken of the benefits that come from ordering standard equipment.

Kilowatts and Kilovolt-Amperes

WITHOUT doubt, power factor—once principally a matter of scientific interest—has become one of the major problems of the central-station industry. The National Electric Light Association, the Association of Edison Illuminating Companies and many of the geographic associations are giving it a place of prominence in discussions and committee work. Engineers are fully aware of its significance, as are also many of the commercial managers. But there are still too many executives who do not appreciate that a satisfactory solution to the "power-factor problem" is of real importance and consequence in the complete success of the undertakings under their direction. However, the increasing amount of industrial load with its usual low power factor is bringing the question rapidly and forcibly into the limelight. The principal point is that low power factor costs a large amount of money to some one—and as things stand at present the biggest loser is the central station. The figures obtained from a survey on an actual system, presented elsewhere in this issue in the interview with W. A. Layman, should impress upon executives who do not already recognize it the importance of power-factor correction.

Engineers and commercial men have suggested various ways of eliminating power factor as a serious problem. Arrangements of equipment, new metering methods and rates have been suggested. But no equipment, no metering or rate method will be largely effective until some of the fundamentals of handling the low-power-factor situation with the customer are satisfactorily worked out and have executive approval. And this time will never come until the executive is fully aware of the cost of low power factor. It must be brought home to every one that only kilowatt-hours are revenue producers while kilovolt-amperes are the principal element of cost. Executives should be the first and not the last to grasp the seriousness of the problem and encourage their engineers and commercial managers to find an adequate solution.

What Is the Basis of a Power-Factor Solution?

THOSE who have made a real study of how to solve the power-factor problem have usually looked for the solution in the direction of making the customer pay for his low power factor or of inducing him to improve it. In general, no one has proposed any other solution. But the problem then becomes a double one of (1) finding a practicable and fair way to inflict a penalty or apply a bonus, and (2) producing a practicable and economical means for the customer to improve his power factor. A recent survey showed that there is a very general feeling that the customer should be penalized for low power factor by some rate schedule. But another survey indicated the rate chaos by showing that by applying various rates to the same kilowatt-hour consumption, at 50 per cent power factor, some bills were as much as 100 per cent larger than others. Few, if any, of these rate schedules penalized a power factor between 80 per cent and unity. And, what is more important, even in the power-factor range to which they applied none of them produced an adequate return on the investment charges necessary to carry the low power factor. Furthermore, no satisfactory metering plan has been devised except that based on measuring kva. demand, and no commercial kva.-demand meter has yet been produced!—though it will be soon, without doubt.

But, even if the customer is sufficiently penalized to cause him to sit up and take notice, means at his disposal to improve his condition are not numerous, nor are they particularly attractive from either the customer's or the central station's viewpoint. And yet it must be recognized that the fundamental of any solution to the power-factor problem is the equipment on the customer's premises. At present his choice lies largely between synchronous motors, synchronous condensers and static condensers. The limitations of all of these for general industrial applications are well enough known and inventors and manufacturers, spurred on by the growing necessity for it, have been working to produce equipment which would be really satisfactory.

It is with more than passing interest, therefore, that the electrical fraternity will view the recently announced "Fynn-Weichsel" motor, or "self-excited synchronous induction motor." Its characteristics indicate it to be a practically foolproof machine of the induction-motor type so far as the industrial user is concerned, but, like the synchronous motor, it has its own power-factor corrective ability as a part of its own equipment. It is not within the province of the ELECTRICAL WORLD to promote the equipment of any individual one of the manufacturers who have all contributed so notably to the advance of the industry. But neither can it fail to note the significance of a development which may have much bearing on a major problem of the industry and which must be judged on its own intrinsic merits. This piece of equipment lies

within that category, and the industry will be quick and glad to accord credit to those who have developed it. And, furthermore, if it proves in commercial practice to be accepted by the industry at large, there will doubtless result inter-licensing arrangements such as have followed many other notable achievements in the industry.

Of course no piece or combination of equipment offers the full solution to the power-factor problem—an incentive, rate or otherwise, is still needed to urge the user to make the correct installation. But it must be made practical to operate industry at high power factor. The more practical it becomes the more insistent will be the demand for a kva.-demand meter and a rate system or some other mechanism to provide the incentive. And the aim must always be toward a fundamental basis of solution, which is to have the user install correct equipment if it can be provided and not merely corrective equipment.

Improvements in Lightning Arresters

THE lightning arrester offers an ever-present opportunity for study and development. This is largely due to the wide variety of duty that it is called upon to perform. There is little definite knowledge as to the nature of the electric pulses which the lightning arrester must absorb, but it is certain that as regards frequency, voltage and energy content they extend over a very wide range of values. It is a great deal to expect that a single appliance, operating without attention, should have such a power of selection as to adapt itself to this wide range of attack. In recent years there has been particular study of the problem found in moderate voltage distribution and transmission circuits, particularly as related to the protection of transformers. It is not so very long since the announcement of the oxide-film arrester marked a considerable improvement in the offerings for this character of service. Within the last year or two the so-called autovalve arrester has been introduced for the same demand. In the former, as is well known, lead peroxide, ordinarily a conductor, is converted into an insulator on the passage of a discharge, thus resealing the arrester after it has discharged. In the autovalve type the high resistance properties of the metal disk serve to reduce the voltage across the spark as soon as it passes, thus giving it the extinguishing property.

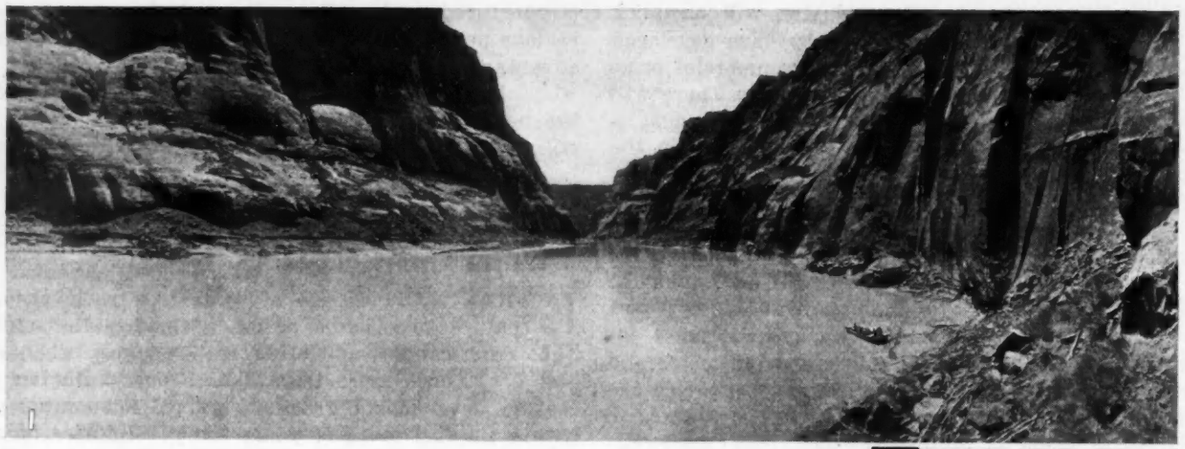
A new improvement in the oxide-film arrester is announced in a paper by N. A. Lougee, presented before the recent annual convention of the American Institute of Electrical Engineers and published in the October number of the *Journal* of that body. The original oxide-film arrester involved an insulating coating between the terminal electrode and the conducting lead peroxide. The new type aims at a simpler, more flexible and cheaper design. The single insulated film next the terminal electrode is absent. Instead the lead peroxide consists of a large number of small pellets about $\frac{1}{8}$ in. in diameter, and these pellets are rolled in an insulating powder. These are poured into porcelain tubes of various sizes, with terminals at each end in contact with the pellets, and a series gap is added. The arrester thus contains a number of pellets both in series and parallel. The overvoltage discharges through the pellets, which have a low resistance, after the powdered film is punctured, and sealing occurs at the contact of the various pellets. The design seems to offer considerable advantages in the way of convenience of assembly and adaptation of arrsters of different rating. Data as to the behavior of the arrester in continued service are still lacking, but they will be looked for with interest.

When Daylight Costs More than Artificial Light

IN IMAGINATION one needs to look backward only a century to reach a period of inadequate artificial light from candles and other feeble flames, when light cost fifty times more than it does now. During that century development gradually gained momentum until within the last score of years the possibilities of artificial light have increased so rapidly that the general public has not been able to keep pace with them. Proper and adequate lighting is just as essential to human progress as clean and sufficient air. The public has a pretty full appreciation of the hygienic value of fresh air. The airtight bedchambers of a century ago have given way to ventilated rooms, but the old attitude toward lighting—a most natural inheritance of centuries of costly and inadequate artificial light—persists far too tenaciously. This attitude cannot be changed too soon in the interests of greater production, greater safety, greater efficiency and greater progress. Human eyes are the product of countless centuries of adaptation to daylight intensities which are more than a thousand times greater than artificial lighting intensities generally but erroneously considered sufficient. The psycho-physiological laws of vision are proof of this, and they are well supported by the results from installations of good lighting.

There is another interesting argument to be derived from recently published investigations (by M. Luckiesh and L. L. Holladay) on the cost of daylight. Daylight is free outdoors when it is available at all. By coming indoors mankind created conditions which not only decreased the intensity available for indoor activities but removed daylight from the free list. These investigations have shown that by charging to daylight the additional cost of windows and skylights, their maintenance, the additional heat losses, etc., natural lighting costs as much as and in many cases more than good artificial lighting. Owing to the growing complexity of our economic life such investigations cannot be ignored. The results are bound to have their influence on buildings in congested districts and perhaps on others.

However, without entering into a discussion of the economic phases, the central-station company and others interested in lighting progress should find much use for the knowledge that daylight indoors costs as much as artificial lighting. In order that the people shall enjoy proper and adequate lighting they must be relieved of the inhibiting attitude that artificial light is costly. That it is a very inexpensive necessity, or that its cost is insignificant as compared with its benefits, can be proved by actual data. But oftentimes an indirect argument is more effective. The simple statement that daylight in homes, offices and factories costs as much as proper and adequate artificial lighting, and sometimes more, is startling, true and convincing—three excellent characteristics for statements made for an educational purpose.



Hydro-Electric Possibilities of the Colorado River

THE Colorado River is a possible source of great hydro-electric developments; but aside from the legal conflicts on questions involving state water rights, irrigation rights and federal rights, the terrain and the location of the dam sites are of a character to impose tasks of immense difficulty in the engineering development of the river. The accompanying views of sites on the Colorado bring out vividly the physical features of the country and give an idea of the great possibilities that proper development contains.

No. 1. Looking down stream through Lee Ferry dam site.

No. 2. Down-stream view of Black Canyon 1 mile below the dam site.

No. 3. Up-stream view of Girand dam site on the Colorado River at the mouth of Diamond Creek. Diamond Creek and power-house site on right.

No. 4. Down-stream view of Boulder Canyon dam site; depth of bedrock 135 ft.

Drying Transformers—I*

When Is It Necessary?—What Determines Method Used?—What Drying Equipment Should Be Used and What Measurements Should Be Made?—Answers to These and Other Questions that Arise in Practice Are Given

By M. E. SKINNER
Assistant to Vice-President Duquesne Light Company, Pittsburgh, Pa.

THE most common reason for having to redry a transformer at its destination is on account of the size of the unit exceeding the limit of dimensions which can be shipped. Other conditions which may make it desirable to redry are:

1. Accidents during shipment which result in the entry of water into the transformer.
2. Accidents during operation or faulty operation, examples of which would be a leaky cooling coil or condensation of moisture in the transformer.
3. Rebuilding in the field to complete repairs or changes.

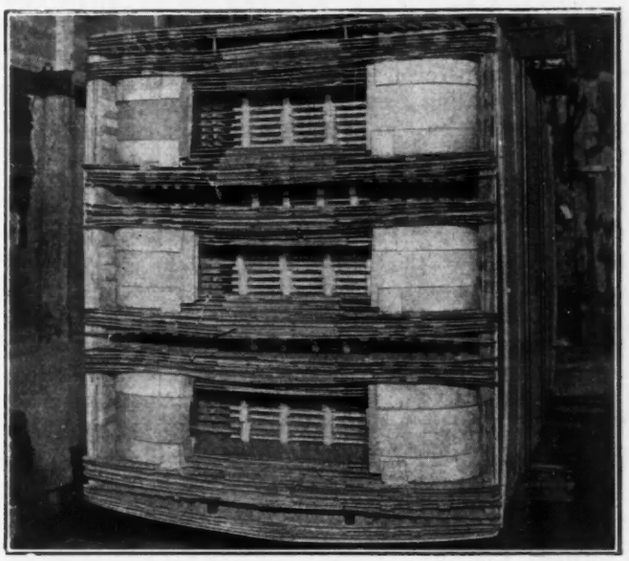
The following questions arise: Is it necessary to dry every oil-immersed transformer which is not shipped under oil? How can one tell whether drying will be necessary or not?

In general, it is rather a difficult thing to judge the condition of dryness of a transformer. Practically the only criterion available is the insulation resistance. This quantity undergoes tremendous changes due to variations in the several factors which influence it and must be used with a great deal of discretion. The most important factors which affect transformer insulation resistance are:

1. Type of construction; i.e., core or shell.
2. Size of the unit.
3. Voltage class.
4. Temperature.
5. Moisture content of insulation.
6. Character and condition of surrounding medium, air or oil.

The effects of these factors on the value of the insulation resistance will be discussed in detail later. At this time it is sufficient to point out that variations due to any one of the above factors may completely mask the difference between the insulation resistance under widely varying conditions of dryness.

The first step to be taken in cases where there is some doubt as to the necessity of redrying is to make sure that the oil in the transformer is in first-class shape. Oil that tests 22,000 r.m.s. volts or better in a standard test cup—i.e., 1-in. disk electrodes, 0.1-in. separation—is satisfactory. After the condition of the oil has been checked the transformer should be heated by circulating current through one winding with the other short-circuited until the whole unit has reached a temperature comparable to that during full-load operation. Then take insulation resistance measurements from high-voltage winding to low-voltage winding, from the high and low voltage windings to the iron. The measurements should be at least 75 per cent of the values measured at the factory prior to shipment before the transformer is fit for service.



HEAT GENERATED BY CIRCULATING CURRENTS IS INSUFFICIENT TO DRY ALL INSULATION IN HIGH-VOLTAGE TRANSFORMERS

With transformers whose highest voltage is less than 16,500 and which have been filled with oil of the proper dielectric strength it is questionable whether drying in the field will ever be necessary. In such units the strength of the oil alone will probably be sufficient to withstand normal voltages.

CHARACTER OF TRANSFORMER INSULATION STRUCTURE

In order to understand the proper drying of a transformer some knowledge of its insulation structure is desirable. The customary insulation from turn to turn or from layer to layer in large power transformers will consist of the insulation wrapped about the conductors, reinforced in certain cases with strips of fullerboard. The thickness of the insulation on the conductor and the separation between adjacent turns depends largely upon the line voltage and the stiffness

*One of the last manufacturing operations prior to the testing of an oil-immersed transformer is the vacuum-drying and oil-impregnation of the insulation. This is one of the most important steps in the manufacture, and much of the success or failure of the unit in operation depends upon the thoroughness with which it is carried out. This process is carried on in steam-heated vacuum chambers large enough to take the completely assembled core and coils. The temperature is maintained steadily at a value as high as is consistent with the life of the insulation material used, and at the same time a partial vacuum is maintained. The combination of long-continued and steady high temperature with low pressure draws out the last vestige of moisture and leaves the insulation in the best possible condition for oil impregnation. At the conclusion of the vacuum-drying period high-grade transformer oil is admitted to the chamber until the windings are completely immersed and, without opening the tank, pressure is applied to force the oil into the insulation until every portion is thoroughly permeated. Obviously, then, the proper thing to do is to place this transformer in its own tank, carefully fill it with oil of proper quality, remove the occluded air and seal up the unit. If the transformer in its own tank with oil meets railway shipping clearances and does not have to undergo sea shipment, it will normally be shipped in this condition. Exceptions would only be made in cases where facilities at the destination would not permit of handling the complete transformer with oil as a unit. That the desirability of this method of shipment has long been appreciated by the large manufacturers is shown by the fact that they control many special cars, constructed in order to extend the limit in rating of transformers which could be shipped complete with oil.

of the conductor and altogether constitutes a very small portion of the total insulation to ground. When the voltages are low the turns will be fairly close together, and heat generated within the conductors will maintain all this insulation at a temperature comparable with that of the conductors themselves. However, when the voltage is high the turns are so far apart that the major part of the insulation between them is far below the temperature of the conductor.

From coil to coil the insulation usually consists of barriers or washers of fullerboard or other insulating material. This may or may not be in direct contact with a coil. Sometimes the washer is placed directly against one face of a coil, but frequently an oil duct separates the washer from the coil on either side. In any event not more than one face of the washer is exposed to the heat of the coil.

The insulation from one winding to another and to ground is ordinarily completely separated from the coils. It consists of heavy insulating barriers interspersed with oil ducts. Heat from the windings penetrates only a very short distance into such insulation on account of the relatively poor heat conductivity of the insulation and because the oil ducts separate this insulation from the windings proper.

The foregoing should make it clear that satisfactory drying of transformers will be a long and uncertain task if circulating current in the windings is the only source of heat in the transformer, as heat generated within the conductors cannot effectively penetrate all parts of the insulation structure. This is quite different from the conditions in the armature of a rotating machine. In the latter case each conductor is insulated for the full voltage of the machine to ground and no other insulation is employed. Thus every portion of the insulation in a rotating machine has a conductor at its center capable of generating sufficient heat to drive all moisture from the insulation. This fact explains the generally used and satisfactory method of drying rotating machines by the use of a circulating current in the windings.

METHODS OF DRYING

To dry a transformer various methods might be employed, namely:

1. By circulating current through the windings.
2. By the application of a partial vacuum in conjunction with the first method.
3. By blowing heated air through the transformers.
4. By a combination of the first and the third methods.

As already explained, method No. 1 cannot be expected to give completely satisfactory results on account of the character of the insulating structure. The only portions of the insulation that would be thoroughly dried by this method would be the insulation from turn to turn. In a high-voltage transformer even this insulation might not be sufficiently penetrated by the heat to drive all the moisture from it. As has been pointed out above, the turn-to-turn insulation constitutes only a small portion of the whole, so that this method cannot be considered satisfactory.

By attaching a vacuum pump to an opening in the case and partially exhausting it, great deal better results can be obtained. However, this method is rather difficult to use in most cases, and requires expensive air pumps which are seldom available and which are not applicable to other work. More serious than this, it requires very special construction of transformer cases, when they are of large size, to make them stand up against the vacuum necessary.

Another method which has been frequently used to dry large transformers is to blow heated air through the ventilating ducts of the transformer. With this method the transformer may be temporarily boxed in, or it may be tanked and suitable baffles arranged so that air entering at the main valve and leaving by the manhole in the cover will have to pass through ventilating ducts in the windings.

From the point of view of the equipment necessary, this method has a decided advantage over the other methods mentioned, and it can usually be carried out with a fair degree of success even with very crude equipment. It is open to somewhat the same criticism as the first method, but the difficulty lies in a different portion of the insulation. In this case it will be the insulation between turns which will be the least exposed to the heat and therefore the last to dry.

By combining the first and third methods—i.e., by circulating a small amount of current through the windings and at the same time blowing heated air through the ventilating ducts—the heat should be carried to every portion of the insulation. This method carries heat to every part of the insulation, provides a constant circulation of air to carry off the moisture as it is evaporated, does not involve anything but very simple apparatus, requires no special features of construction and affords the easiest and most reliable method of controlling the temperature. The discussion which follows will be limited to this method.

DRYING IN TANK VERSUS DRYING IN TEMPORARY HOUSING

Some transformers may most conveniently be dried out by removing them from their tanks and providing a temporary housing. Others can be dried in their own tanks. The determining feature is the ease with which baffles can be placed so as to force the air through the ventilating ducts. With the shell type of construction it is a relatively simple matter to place baffles between the transformer itself and its tank so as to force all the air to pass up through the ventilating ducts in the coils. The heated air is admitted through the drain valve and allowed to escape through the manhole in the cover. Drying a transformer in its own tank has several advantages. First, it largely eliminates inflammable material other than the insulation of the transformer itself. Second, it permits of filling the transformer with oil and sealing very promptly after the completion of the drying, as all connections can be put in place before drying is started. Third, it conserves space. Fourth, it protects the windings from possible injury, this being especially important when plant construction is still in progress.

Practically the only objection which can be raised to this method is the loss of heat from the tank by radiation. Unless steps are taken to minimize this loss, it may be of considerable magnitude. For example, a tank 6 ft. in diameter by 10 ft. high, at a temperature of 40 deg. C. above that of the surroundings, would dissipate between 6 kw. and 7 kw. of heat energy. Fortunately, this loss can be greatly reduced by lagging the tank or wrapping tarpaulins about it. As the transformer is dried a considerable quantity of oil along with some water and dirt will collect in the bottom of the tank. This must, of course, be swabbed

out carefully. In most cases it can be reached through the main drain valve as the practice of locating the drain valve so that it is flush with the bottom of the tank is now fairly well established with manufacturers. In the case of old transformers, where the drain valve is not arranged so conveniently, the difficulty of satisfactorily reaching this condensate may work against drying the unit in its tank.

It is always necessary to cover the manhole so as to prevent dirt and construction material from dropping through the manhole into the transformer windings. It should be possible to construct this cover in such a way that it will act as a chimney and in so doing will materially aid the circulation of the hot air through the transformer. It has actually been found in practice that the use of a chimney from 2 ft. to 3 ft. in height, extending above the manhole of the transformer, will increase the circulation of air through the ducts of the transformer to such an extent that baffles may become unnecessary. It also will result in maintaining a higher temperature at the point where the air leaves the transformer bank as it decreases the radiation of heat from the tank wall. Cases have been observed where the addition of such a chimney has increased the temperature of the air leaving the transformer by as much as 15 deg. centigrade.

With a transformer of the core form of construction it will usually be desirable to construct a temporary housing to force the air through the ventilating ducts. This will most conveniently be made of wood and should be lined with asbestos in order to prevent its catching fire.

Electrified Copper Mine

Description of Installation of the United Verde Copper Company at Jerome, Ariz.—Underground Hoisting Stations Used—Flexibility and Economy of Electrification—Unusual Ore-Bin Selector

By J. B. JOHNSON* and C. L. GERHARDT†

PRIOR to 1916 the United Verde Copper Company at Jerome, Ariz., had operated its haulage system, pumping and ventilating plants and surface shops with electric power. The demonstrated economy and flexibility of this installation in combination with a desire to use steam shovels in the upper workings of the mine led the company to start a program of development in 1917 which contemplated the abandonment of the steam surface plant and surface hoists and their replacement by electrified hoists and compressors. It was decided to place both hoists, one for service and men and one for ore, in underground stations in order to permit surface steam-shovel and underground mining operations to continue simultaneously.

Previous to the decision to electrify, a careful study of the situation was made by the engineering staff to determine the merits of electrification. The greater over-all efficiency of the electrical installation, the flexibility of such an installation and its adaptability to many mine operations, the possible economies in operation, safety features and the possibility of using schedules and equipment for giving a fairly uniform load were deciding elements for electric operation.

Previous to 1916 large electric mine hoists were viewed with some trepidation. However, the large installation at Inspiration, Ariz., and later the North Butte and Elm Orlu installations in Montana had largely dispelled any doubt as to safety and ease of operation. It is noteworthy that during the two years of 1916 and 1917 more horsepower in such hoists with Ward Leonard and Ilgner-Ward Leonard control was installed than was installed altogether previous to 1916. The direct-current hoist motor supplied by a motor-generator flywheel set has largely solved the control and high-peak difficulties incident to direct-current motor drive.

In the selection of electric hoists for the two main hoisting units the chief advantages considered, aside from power economy, over prime movers of the reciprocating type were:

1. The turning moment of the electric motor is uniform throughout each revolution, relieving the hoisting rope of high stresses due to jerking. This in turn does away with flapping and thus reduces the number of idler pulleys required. Hoisting ropes with a smaller factor of safety may be used. The life of the hoisting ropes is increased.

2. Owing to uniform torque of the motor, good speed regulation and greater safety of operation and higher operating speeds are permissible.

3. Owing to high efficiency, even at varying loads, cylindrical drums may be used for deep shafts, whereas with steam-driven conical drums a tail rope is necessary. The first cost is therefore lower and complicated rigging is avoided.

4. The electric hoist is adapted to installations underground as readily as on the surface.

5. The electric hoist is more easily adapted to automatic safety devices and automatic operation; therefore fewer skilled operators are required.

It is a fact that the over-all efficiency of the motor-generator flywheel set and hoist motor over a twenty-four-hour period, during which the hoist is idle for a large percentage of the time, is necessarily low. The steam hoist, however, under the same conditions of low-capacity factor, must necessarily bear a high standby charge for the steam plant. This results in a lower over-all efficiency for the steam hoist. It has been estimated in the case of the United Verde that with the old steam-plant generating steam at 125 lb. pressure 80 lb. of steam was consumed per shaft horsepower-hour. On the No. 5 hoist the power input to the motor-generator set over a period of a year has averaged 1.35 kw.-hr. per shaft horsepower-hour. To use the above figures for comparison of the actual costs at Jerome

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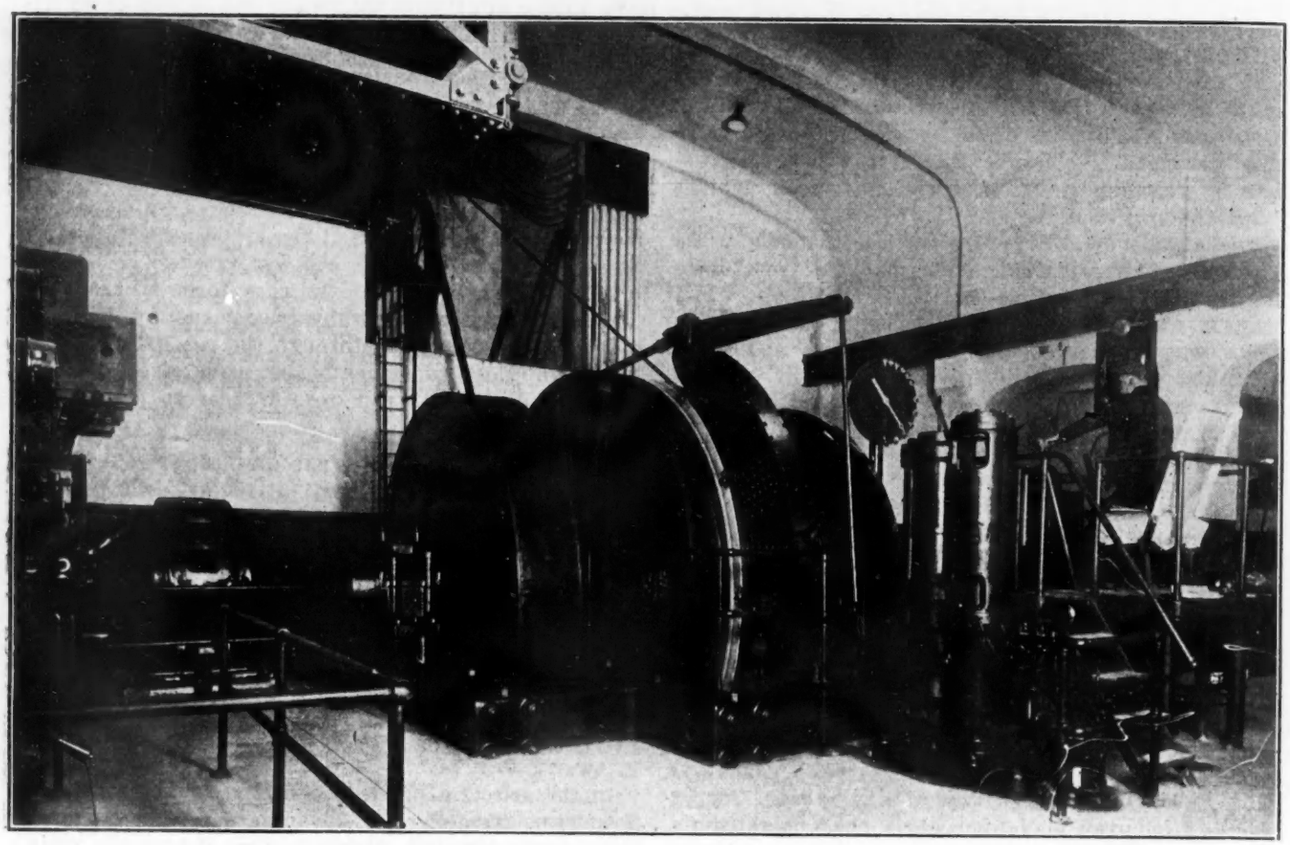


FIG. 1—GENERAL VIEW OF HOISTING STATION FOR ORE SHAFT

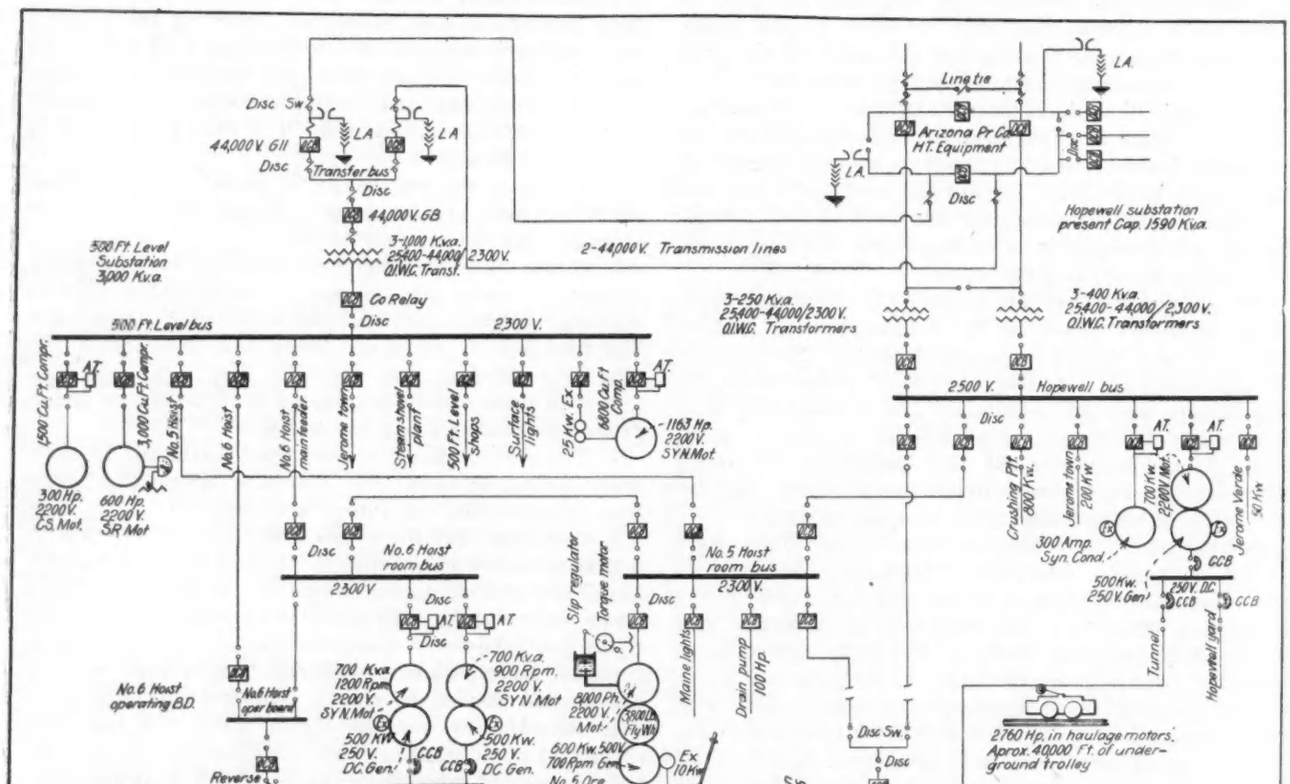


FIG. 2—RING-FEEDER POWER SUPPLY FOR MINE

would be misleading owing to the great discrepancy between steam costs based on oil fuel and low generating efficiency, on the one hand, and the price paid for electric power as purchased from the power company, on the other hand. A comparison of power economy can, however, be quickly made by converting the consumption of electrical energy as shown by the meter reading to steam consumption, using 20 lb. of steam, gross, per kilowatt-hour. This steam rate would compare favorably with that which could be obtained from the old steam plant at Jerome. On this basis the power consumption of steam hoists versus that of electric hoists will be in the ratio of 80 to 27. This indicates a decided saving in power in electric hoisting.

After preliminary considerations had resulted in a decision to adopt electric hoists the type of equipment was carefully considered. The Ilgner-Ward Leonard system of electric drive and control was selected for the No. 5 ore hoist. Later, induction-motor drive was selected for the No. 6 service hoist, which is controlled with primary contactor and liquid secondary resistance. Excessive peaks are avoided on the No. 6 hoist by means of a counterweight attached to a fixed reel on the drum shaft. Such a combination happened to suit the hoisting conditions admirably, as will be explained later. The combination of No. 5 and No. 6 hoists operating on predetermined schedules has worked out to good advantage as far as making a uniform load curve for hoisting is concerned. The service hoist has its period of high duty at the beginning and end of each shift, while the duty of the ore hoist is greatest between these periods. In addition, the rate of hoisting ore can be governed to utilize to the fullest extent the flywheel regulation. The periods of time during which the ore hoist is idle are scheduled beforehand, so that the motor-generator set may be shut down entirely during these periods to reduce the idle time of the generator.

POWER-DISTRIBUTING SYSTEM

The mine at present is supplied with power from the Arizona Power Company and uses an average of 1,000,000 kw.-hr. per month when mining 60 000 tons of ore per month, or 16.7 kw.-hr. per ton. Power is delivered at both the Hopewell and the 500-ft. level substations at 44,000 volts and stepped down to 2,300 volts. The tansformer capacity at Hopewell is 1,950 kva. and at the 500-ft. level 3,000 kva. Direct current for the haulage system is supplied by two 500 kw., 250-volt motor-generator sets installed underground in the room adjoining the No. 6 hoist station. Either machine will normally handle the load, but as the peak load is quite large extra capacity is provided.

Fig. 2 shows the general connection diagram of the entire mine power scheme. It will be noted that the whole constitutes a ring feeder, permitting feeding through either the Hopewell tunnel or the 500-ft. level tunnel. The double-circuit high-tension steel-tower line from Hopewell substation to the 500-ft. level substation is particularly well built and insulated. Lightning arresters and selective relays are provided. The locality is subject to severe lightning storms during summer months, and every precaution is taken to insure continuity of operation. A shutdown in the mine means more than loss of working time. Interruption of service on ventilating fans, lights and hoists is a very serious matter.

The main feeders in the mine were a source of considerable trouble in the early days because of acid water. In dry places ordinary 5,000-volt varnished-cambric double-braid cable in iron conduit is used for 2,300-volt circuits on horizontal runs. For damp or wet places in the newer installations three-conductor varnished-cambric, lead-covered, band-steel-armored, jute-covered cables have been used for horizontal runs. These are sectionalized by potheads placed at intervals in waterproof concrete or steel boxes to facilitate replacing damaged sections. On the vertical runs in the shafts steel-wire armored cables are used. These are provided with tight tie bands spaced 15 ft. apart to prevent the copper conductor with its insulation from slipping inside the armor. The cables are suspended in fiber conduit set in the concrete walls of the shafts. Recessed concrete pull boxes are provided at main landings facing away from the shaft. From the bottom of these boxes the cables are suspended from the armor wires. The method of making the suspension is as follows: The armor wires are cut and banded and bent back 180 deg. and leaded into a socket. Under this socket a heavy split clamp is fastened on the cable over the armor. The socket rests on the clamp, which in turn rests on a steel sill in the bottom of the concrete pull box. The 2,300-volt cables are sectionalized by potheads placed in the pull boxes. A waterproof cover is fitted over the boxes.

SURFACE PLANT

The surface plant was completed in 1921 and consists of power house, substation, change house and time office, warehouse, machine shop, boiler and blacksmith shop, mine shop, electric shop and a complete complement of storage sheds, racks and accessory buildings. A uniform type of construction was carried out in all these buildings. They are of concrete, brick and steel construction, fireproof throughout. The machine-tool units in all the shops are of the most modern design, driven by individual electric motors throughout. All shops are equipped with overhead service cranes. The machine shop is equipped with a motor-operated locomotive jack capable of lifting a Mallet locomotive weighing 230 tons.

The change house has locker and dressing accommodations for 1,400 men. Shower baths and lavatory accommodations are provided. Adjoining the change room are the time and check offices and separate quarters for foremen and shift bosses. The entire plant is built on a wide bench on the hillside 500 ft. below the original surface plant. Construction of the surface plant began early in 1919 and was completed, including all the divisions enumerated above, at a total cost of a little over a million dollars.

UNDERGROUND ORE HOIST

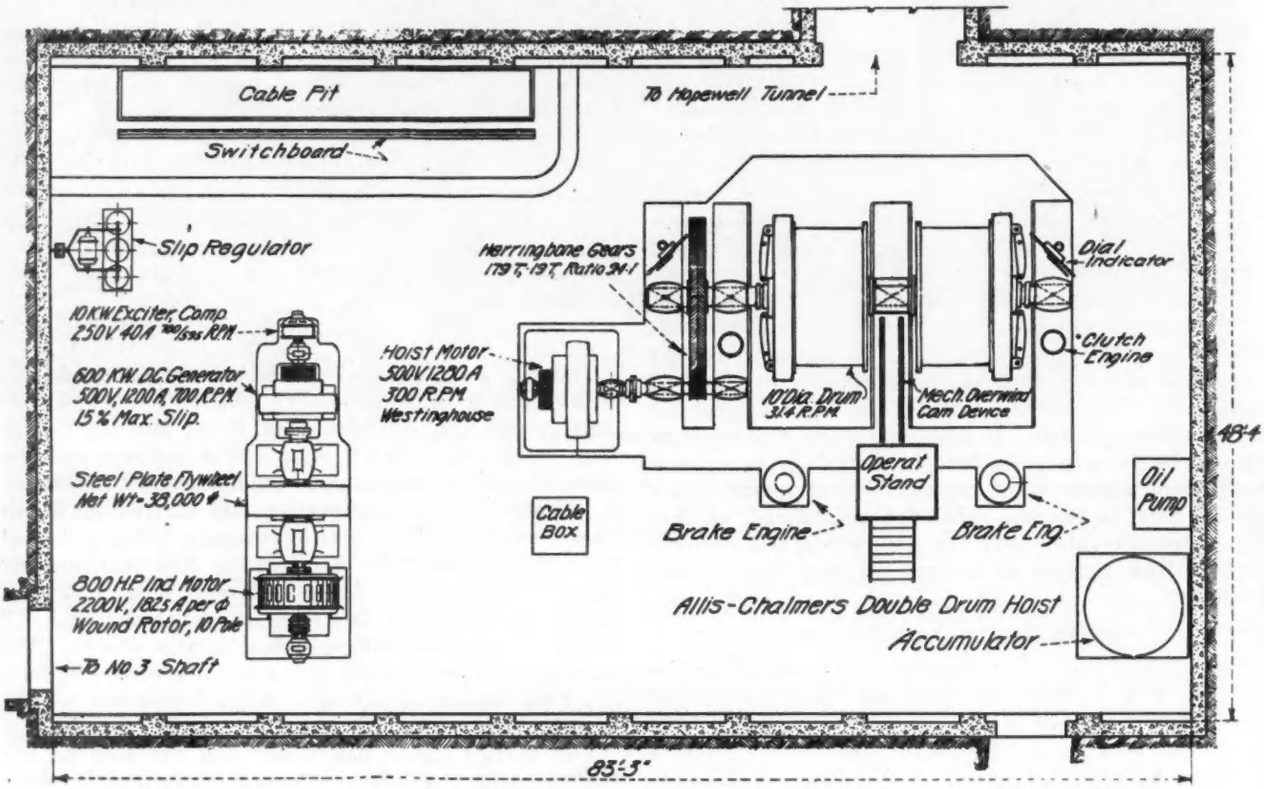
The new ore shaft, known as No. 5 shaft, was sunk first. It is a three-compartment concrete-lined shaft, with 7-ton ore skips operating in balance. As all of the ore is taken out to the surface through the main haulage tunnel on the 1,000-ft. level, the hoisting station is located on this level and accommodates a large double-drum electric hoist and accessory equipment, described in detail later. A general view of this station is shown in Fig. 1. This hoist and shaft to the 1,950-ft. level was completed in the summer of 1918 and put into service immediately following. Previous to that time all ore was hoisted on cages in the old No. 3 shaft, a timber-lined shaft recently abandoned. A

steam hoist served this shaft and the cages operated in balance.

A comparison between hoisting costs in 1917 with steam and costs in 1920 with electric power may be roughly considered as indicative of the economy of electric hoisting over steam. In 1917 average hoisting costs with steam were 23.3 cents per ton. In 1920 average hoisting costs with electric power were 1 cent per ton. The saving in power in this instance does not account for the great difference in hoisting costs. An important contributing factor was the automatic loading and dumping feature of the new shaft. This feature reduces enormously the labor cost involved as compared with the old way of handling cars in and out of the cages. An arrangement by which the ore dumps from the skips into any one of three bins under the control of the hoist engineer is also a novel scheme. This is operated by an electric motor with remote control. The push-button control is on the hoist engineer's platform. By pressing any one of three control buttons a swinging spout is spotted over the desired bin. This arrangement is described later.

When hoisting for three shifts this shaft has a capacity of 5,000 tons of ore per day. Up to date, however, not more than 40 per cent of its capacity has been realized. Much consideration was given to safety of operation in the design of hoist, shaft and accessories. Protection has been installed against overwind and overspeed. These safety devices operate to disrupt the current and automatically set the brakes. The equipment as a whole combines large capacity with safety of operation and ease of control.

The hoisting equipment is installed underground on the 1,000-ft. level. The station is cut out of solid rock and lined with reinforced concrete. Fig. 3 is a floor plan indicating the main units of equipment. This room houses the motor-generator flywheel set, switchboard, slip regulator, double-drum hoist, oil accumulator and the necessary signal apparatus. The room is well lighted and painted and presents a surprise to the visitor seeing it for the first time. The Ilgner-Ward Leonard system for load equalization was adopted, not because of any reservation on demand charge, but to secure better voltage regulation. Flywheel capacity sufficient completely to equalize the maximum-duty cycle met in balanced hoisting from the deepest level was provided. The shaft has recently been sunk to a depth of 2,700 ft., and ore is being hoisted from loading



GENERAL PLAN NO 5 HOIST ROOM
ON 1,000 FT. LEVEL

FIG. 3—FLOOR PLAN OF HOISTING STATION FOR ORE SHAFT

pockets 76 ft. below the 1,200, 1,500, 1,800, 2,100 and 2,500-ft. levels. Ultimately the shaft will be sunk to the 3,000-ft. level. The general characteristics of the hoist are given in Table I. The calculated duty cycles for various levels on which the capacity of the electrical equipment was based are shown in Fig. 4.

The hoist is of the double-drum, single-reduction, geared type. There are two drums 10 ft. in diameter

TABLE I—CHARACTERISTICS OF NO. 5 HOIST EQUIPMENT

Inclination of shaft with horizontal, deg.	90
Present maximum lift, approximately, ft.	1,100
Ultimate maximum lift, approximately, ft.	2,200
Weight of skip, lb.	12,000
Weight of ore per trip, lb.	14,000
Weight of one rope (2,200 ft. 1¼ in.), lb.	7,500
Maximum speed of skip, hoisting, ft. per minute	1,000
Diameter of double-clutched cylindrical drums, in.	120
Moment of inertia of revolving parts, ft.²-lb.	2,691,430
Maximum hourly tonnage (2,000-lb. ton) from 3,000-ft. level, tons	163.6

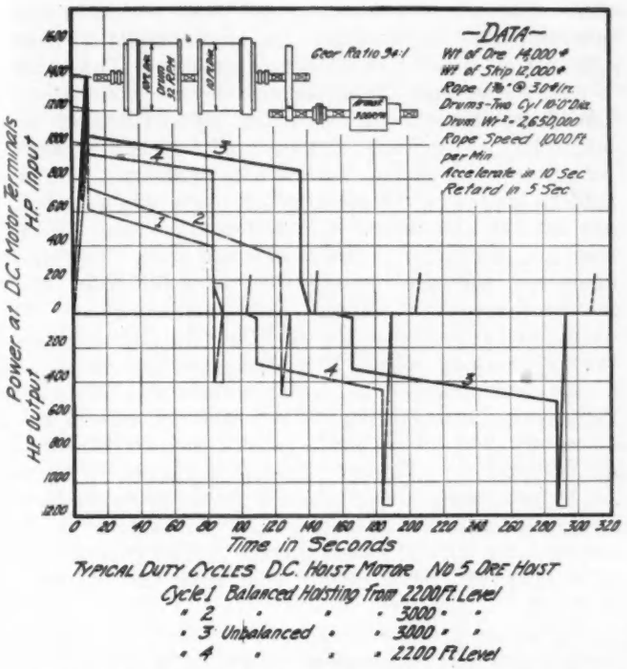

—DATA—
Wt of Ore 14,000#
Wt of Skip 12,000#
Rope 1⅛" @ 30#/ft.
Drums-Two Cyl 10'0" Dia.
Drum Wt²- 2650,000
Rope Speed 1000 Ft. per Min
Accelerate in 10 Sec
Retard in 5 Sec
Gear Ratio 34:1
Power at D.C. Motor Terminals H.P. Input
H.P. Output
Time in Seconds
TYPICAL DUTY CYCLES D.C. HOIST MOTOR NO 5 ORE HOIST
Cycle 1 Balanced Hoisting from 2200 Ft. Level
" 2 " " " 3000 " "
" 3 Unbalanced " " 3000 " "
" 4 " " " 2200 Ft Level

FIG. 4—THE CAPACITY OF THE EQUIPMENT FOR THE ORE-HOISTING STATION WAS DETERMINED FROM CALCULATED DUTY CYCLES

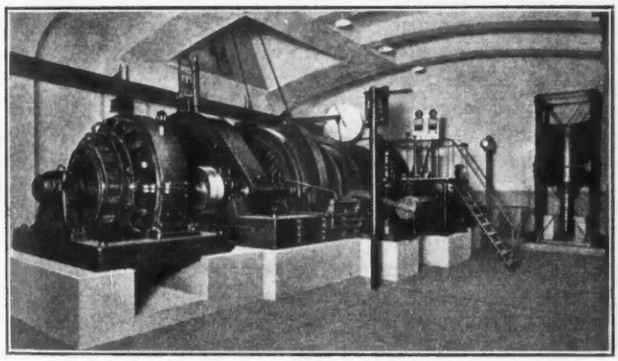


FIG. 5—GENERAL VIEW OF UNDERGROUND HOISTING STATION FOR SERVICE PURPOSES

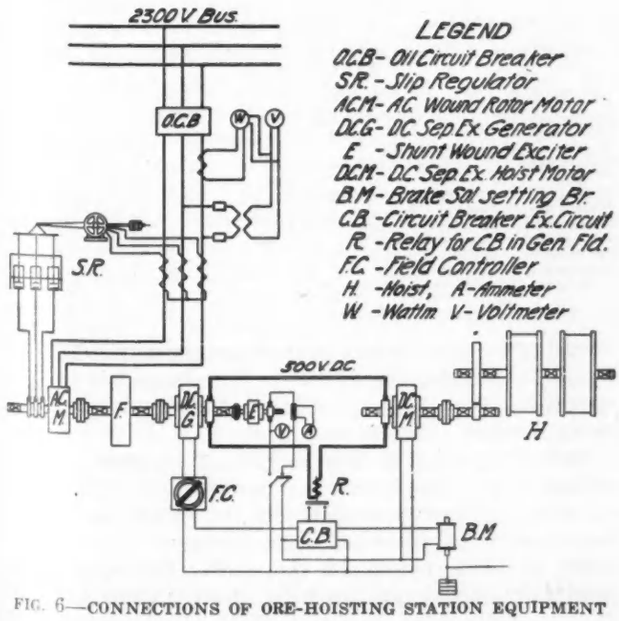


FIG. 6—CONNECTIONS OF ORE-HOISTING STATION EQUIPMENT

and with 5 ft. between flanges. The shell is made of 1⅜-in. rolled open-hearth plate steel, machine-grooved after being assembled with a 1⅞-in. pitch for 1¼-in. steel rope. The shells are bolted to cast-steel spiders. The brake wheel and clutch ring are of cast steel. The brake-wheel diameter is 12 ft. The clutches are of Brown patent double-disk multiple-arm friction type. Both clutches and the parallel-motion post brakes are operated by auxiliary engines 7-in. x 10-in. stroke, actuated by oil under a pressure of 200 lb. per square inch. The brake is set by weight and released by oil pressure. The post brakes are made from structural shapes and rolled open-hearth steel plate formed into a substantial box girder. The weights by which the brakes are set are in the form of cylinders moving in vertical guides formed by the brake engine frame. The drum flanges are extended to afford a large surface for spotting marks. The four drum-shaft bearings are of the two-part type, provided with gravity-feed lubrication. The outside bearings are 13 in. x 20 in. and the two middle bearings 16 in. x 28 in.

The drum shaft is connected through a flexible coupling to a Westinghouse 500-volt, 800-hp., 300-r.p.m., direct-current, separately excited, shunt-wound motor. The motor has ten poles wound for an exciter voltage of 250. The motor receives its armature current from a 500-kw., 500-volt, 595/700-r.p.m., separately excited, six-pole, direct-current generator. The generator is rated on a 40-deg.-C. temperature rise for full-load operation for twenty-four hours, followed by a four-hour run at 125 per cent load, during which time the temperature is not to rise over 55 deg. C. above room temperature. An 800-hp., 2,200-volt, 700-r.p.m., three-phase, 60-cycle, alternating-current slip-ring induction motor drives the generator and flywheel. A 7½-kva., 250-volt exciter is directly connected to the motor. A general connection diagram is given in Fig. 6.

The flywheel is made up of separately turned steel plates riveted together. The weight of the wheel is 38,000 lb. and the diameter is 7 ft. 6 in. The peripheral speed of the wheel is 16,956 ft. per minute at synchronous speed. The total energy stored in the flywheel at 700 r.p.m. is 40,000 hp.-sec. Approximately 50 per cent of this energy is available in case of power failure, the limitation being the speed at which the direct-current exciter is no longer able to hold its voltage. The set is rated on the basis of a speed reduction of 15 per cent below 700 r.p.m. At this slip the flywheel will give up 3,030 hp.-sec. of energy.

The hoist motor is controlled by a face-plate field controller through a hand lever moved in a vertical plane. The induction motor driving the direct-current generator is controlled by a liquid slip regulator actuated by a torque motor, the current in which is proportional to the current in the main motor. Hatchway limit switches are provided to limit the skip travel positively in the mine shaft. In addition, a mechanical overwind device is geared to the hoist. A traveling electric crane serves all machinery in this station. Repairs, when necessary, can be quickly made, but so far the hoisting equipment has needed no major repairs.

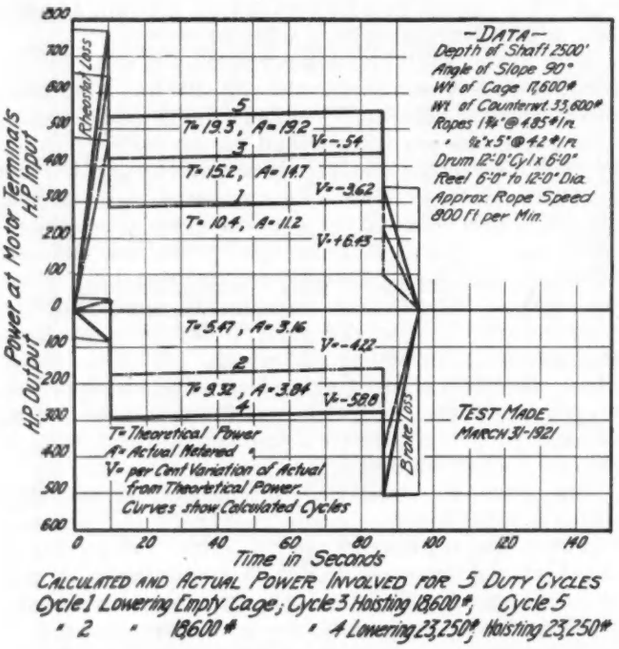
ORE-BIN SELECTOR

A special feature of particular interest is the so-called selector. This consists of a movable hopper with a chute which swings through a horizontal angle of 120 deg. on a curved track. The skip discharges into this hopper, and in front of the hopper three separate

openings lead to grading bins just above the 1,000-ft. level. The drive for the hopper consists of remote-controlled equipment identical in principle with an automatic elevator. Push-buttons on the hoist operating platform make it possible for the operator to spot the chute over the proper bin while the skip is being hoisted and dumped. The equipment is entirely under the control of the hoisting engineer. It has proved reliable and unfailing during the three years it has been in operation.

No. 6 Service Hoist

The service hoist is on the 500-ft. level of the mine in an underground station. This station is connected with the surface plant on the same level by a standard-gage tunnel 1,650 ft. long. The tunnel makes a loop connecting also the cage and shaft collar station on the same level. The sheave station is about 100 ft. above the hoist level and houses the two main sheaves, one



CALCULATED AND ACTUAL POWER INVOLVED FOR 5 DUTY CYCLES
Cycle 1 Lowering Empty Cage; Cycle 3 Hoisting 18,600#, Cycle 5
" 2 " 18,600# " 4 Lowering 23,250#, Hoisting 23,250#

FIG. 7—COMPARISON OF CALCULATED AND ACTUAL DUTY CYCLES ON SERVICE HOIST

for the main hoisting rope and the other for the counterweight rope. The hoist station is a room 44 ft. x 45 ft. with an adjoining room 28 ft. x 22 ft. These are excavated out of solid rock and lined with reinforced concrete. The smaller room houses the direct-current generators which supply all direct current for the underground load. As the haulage load comprises the larger part of the demand, this location was chosen as the most central underground station. It also has the advantage of being in direct communication with the main surface plant through a short tunnel. Fig. 5 shows a general view of the hoist, looking at the reel side, which is also the driving end of the hoist. At the extreme left is shown a part of the control switchboard panels, and overhead is shown a part of the cage of the traveling overhead service crane.

The hoist is a combination of a single cylindrical drum and reel, single-reduction-geared and coupled to the motor. The drum takes the main round hoisting rope and the reel carries the flat rope for the counterweight. This combination produces a remarkably flat load curve and cuts down the otherwise excessive acceleration peak. Mechanically the arrangement is unusually simple, since no clutch is necessary. The control is entirely through the motor and the mechanical brake. The drum is made in halves and constructed of steel boilerplate 1½ in. thick, not grooved. It is designed to wrap the rope in two layers on the drum. The end spiders are of cast steel and the brake drum and reel are cast in one piece. Circumferential rings of cast steel are placed inside the steel drum shell. The entire drum and reel are mounted on one solid 16-in. shaft having three main bearings each 16 in. x 27 in. The drum shell is bolted to the spiders with machined bolts through reamed holes. The main gear and pinion are of the herringbone type, which admits of a large gear ratio with high efficiency. The brake drum is 14 ft. in diameter. The brakes act in parallel, are wood lined and are operated by means of a hydraulic engine. They are set by dead weight and released by oil pressure in the hydraulic cylinder. Oil pressure is supplied by an accumulator with a loaded plunger. The general characteristics of the hoisting equipment are given in Table II.

The motor is a 350-hp. 2,200-volt twenty-pole wound-rotor motor with magnetically operated primary reversing switches and liquid rheostatic speed control. The motor is built for "plugging service," 40 deg. C. temperature rise on continuous operation at full load. The control is by hand lever operated through a vertical arc.

Power consumption on light-load lowering and empty hoisting, which represents average chaser conditions, is at a minimum. A comparison of calculated duty cycles and actual duty cycles was obtained by a test. The results of this test are shown in Fig. 7. It was found that the theoretical calculations were very nearly correct. The power-input curves from test showed little variation from the calculated values. The power output fell considerably below the theoretical values on regenerative lowering owing to the fact that negative slip was retarded by brakes. In this case the full energy of the descending load was only partially transformed into electrical energy, the rest being absorbed by brake lining. The test was made very soon after the hoist was put into operation, and the operator was unfamiliar with the equipment. Full regenerative lowering is more nearly approached now, and friction has been considerably reduced. The hoist has been in operation for a little more than three years and has given unusual satisfaction.

TABLE II—CHARACTERISTICS OF EQUIPMENT FOR NO. 6 SERVICE HOIST

Inclination of shaft with horizontal, deg	90
Depth of shaft, (present), ft	2,700
Weight of double-deck cage, lb	17,400
Weight of men or material (maximum), lb	15,500
Weight of 1½-in. hoisting rope, lb	12,125
Weight of ¾-in. x 5-in. counterweight rope, lb	8,232
Weight of counterweight, lb	31,600
Maximum hoisting speed, ft. per min	800
Diameter of cylindrical drum, in	144
Diameter of reel, minimum, ft	6
Diameter of reel, maximum, ft	12
Moment of inertia of revolving parts, ft.²-lb	2,500,000

Full protection is provided on this hoist against overwind, overspeed, failure of current and carelessness of hoist operator or cage tender. Duplicate protection is provided for overwind. One means is by hatchway limit switches placed in the shaft, the other by a mechanical device on the hoist itself. Cams are con-

nected to the hoist drum and operate to shut off the current automatically and gradually set the brakes at the end of the run. In case of overspeeding a centrifugal governor operates with the same result in stopping the hoist. In case of failure of current the hoist is immediately brought to rest. Any attempt to overwind or start the hoist in the wrong direction will result in the instant application of the brakes and shutting off of the power. A pull-out switch is installed on the hoisting engineer's platform, enabling him to cut in the current to move the hoist in case of overwind or other operation which results in shutting off the current. The mechanical safety devices operate each trip, thus insuring that they will be always in working order. However, they will not cause the hoist to stop if the operator wills at any time to handle the controller lever and control the hoist by hand in the ordinary safe manner. Protection against carelessness of the cage tender is obtained by door lock switches on all doors in the shaft at the different levels. The current is disrupted by any open door, so that the cage cannot be moved while a door is open at the landing or while any door above or below the cage is open. The cage is double-decked and will hold 125 men. Less than one-fifth as much time is required in getting the men in and out of the mine as formerly with the small cages in the No. 3 shaft. This effects a large saving in operating costs due to the conservation of working time.

The underground haulage system consists of approximately 40,000 ft. of narrow-gage and about 10,000 ft. of standard-gage track, with 250-volt overhead trolley. There is 2,760 hp. in haulage motors and locomotives working on the various levels. From the main loading bins on the 1,000-ft. level ore is loaded into 40-ton cars, ten of which are hauled by 25-ton Westinghouse-Baldwin two-motor locomotives through the Hopewell tunnel to the crushing plant at Hopewell. From here a steam road hauls the ore to the Clarkdale smelter. There is a locomotive repair shop at the mouth of the tunnel. Three-ton storage-battery locomotives of 18-in. gage are used on the 500-ft. level for drill-steel and miscellaneous service. Standard-gage 6-ton motors are used to haul the trains for the workmen between the portal and the shaft.

The high-pressure air-compressor plant is located with the rest of the surface plant on the 500-ft. level, about 700 ft. from the tunnel portal. The building is of modern steel and brick construction, 64 ft. x 126 ft. and 35 ft. high. A 20-ton traveling crane is provided to handle repairs to the compressors. The equipment consists of three two-stage Ingersoll-Rand compressors with capacities of 1,500, 3,000 and 6,800 cu.ft. per minute. The two smaller machines are driven by induction motors of 300 hp. and 600 hp. respectively and the large machine by a 1,163-hp. synchronous motor. Space is provided for one future compressor 6,800 cu.ft. or larger in size. This building also houses the main mine-power switchboard. This contains the distributing switches for all departments of the mine and surface plant and the town of Jerome.

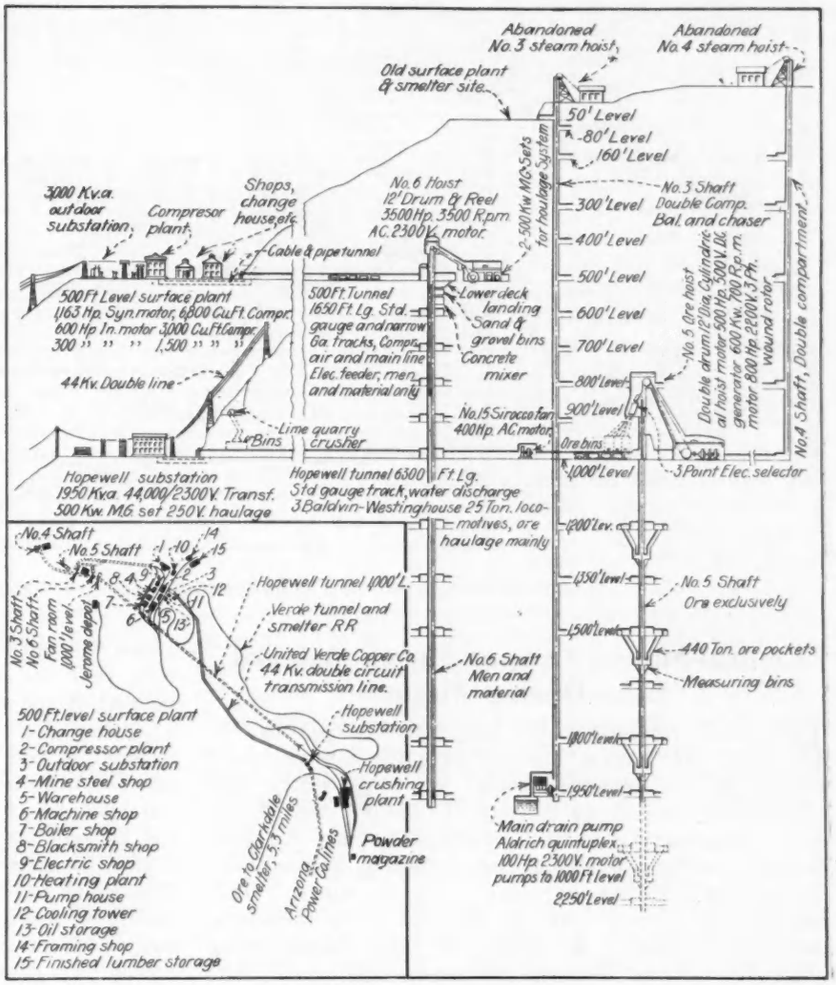


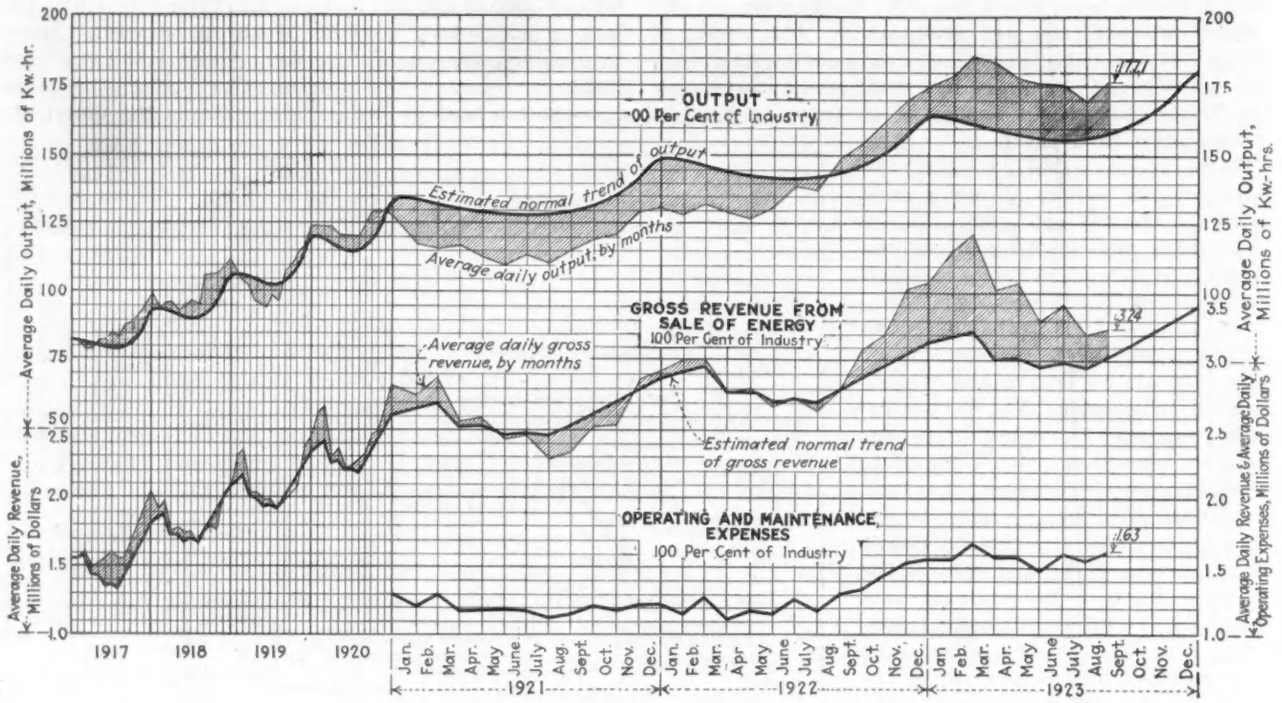
FIG. 8—VERTICAL SECTION THROUGH THE TWO SHAFTS AND THE RELATIVE LOCATION OF HOISTING STATIONS

No. 3 and No. 4 shafts, both of which have been abandoned for hoisting but will be kept open as air shafts, are also shown. No. 3 shaft has been used recently as an emergency shaft, the old steam hoist being operated by compressed air. The small-scale map of Fig. 8 indicates in a true proportion the surface plant, railroad, main power-transmission lines and the main underground haulage tunnels on the 500-ft. and 1,000-ft. levels. It also shows the four shafts above mentioned in their true respective locations and the underground hoist room and other equipment.

Table III gives test data on the power consumption of the air compressors. The cost in 1918 and 1919 with part steam-driven compressors in the old plant was 13.5 cents per ton of ore mined. For 1920, with all compressors run by electric power, in the new plant the average cost was 5 cents per ton of ore.

TABLE III—POWER CONSUMPTION OF AIR COMPRESSORS

	Kw.-Hr. per 100 Cu.Ft. Free Air Compressed to 100-Lb. Gage				Hp. per 100 Cu.Ft. of Air per Minute Compressed to 100-Lb. Gage			
Load:	4/4	3/4	1/2	1/4	4/4	3/4	1/2	1/4
6,800-cu.ft. compressor	0.2205	0.225	0.283	0.385	17.65	18.18	22.85	31.90
3,000-cu.ft. compressor	0.264	.....	0.348	.....	21.2	.....	27.9	.....
1,500-cu.ft. compressor	0.239	0.241	0.319	0.489	19.2	19.35	25.6	39.5


OUTPUT
100 Per Cent of Industry
Estimated normal trend of output
Average daily output, by months
GROSS REVENUE FROM SALE OF ENERGY
100 Per Cent of Industry
Average daily gross revenue, by months
Estimated normal trend of gross revenue
OPERATING AND MAINTENANCE EXPENSES
100 Per Cent of Industry
Average Daily Output, Millions of Kw.-hr.
Average Daily Revenue, Millions of Dollars
Average Daily Revenue & Average Daily Operating Expenses, Millions of Dollars
Average Daily Output, Millions of Kw.-hrs.
1917
1918
1919
1920
1921
1922
1923

CENTRAL-STATION OUTPUT DURING AUGUST WAS 11.9 PER CENT ABOVE NORMAL

Central-Station Output Shows Material Gain During August

REPORTS received by the ELECTRICAL WORLD for the month of August indicate that the average daily output of the central stations of the country was 177,090,000 kw.-hr., as against 169,438,000 kw.-hr. for July. August is the first month following the mid-summer season in which the increased demand for energy for lighting purposes is to be noted. This increase in energy sold to consumers is, therefore, perfectly normal. A study of the accompanying diagram indicates that the central-station output during August was about 11.9 per cent above what would have been the seasonal energy requirements if the industry had been normal. During July the industry was operating at 8.2 per cent above normal. A very significant fact to be drawn from the August returns is that while in January of this year the output was 28.6 per cent above the output of January, 1922, the output for August of this year was only 17.4 per cent above the output for August, 1922. The fact, therefore, that the output of the industry for the first six months of the year showed a gain of 25.4 per cent over a similar period for 1922 does not necessarily mean, in light of the returns for July and August, that the output of the industry can be said to be doubling every four years. It is very possible that by the time the full returns for this year are compiled the output for 1923 will exceed that of 1922 by about 20 per cent. The gross revenue from the sale of energy for the month of August also showed a slight gain over July, but not in proportion to the gain which was made in the output. The average daily revenue during August was $3,238,000, which is 7.4 per cent above what would have been the revenue if growth in the industry had been normal.

CENTRAL-STATION RETURNS FOR THREE MONTHS

Mos.	Percentage of Installed Ratings Represented	Kw.-Hr. Output (Companies Reporting) 1923 Thousands	1922 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	Revenue from the Sale of Energy (Companies Reporting) 1923 Thousands	1922 Thousands	Per Cent Increase
June..	75	3,965,060	3,321,108	19.3	69	$71,456	$60,215	18.7
July....	76	3,992,017	3,301,527	20.8	70	69,557	58,923	18.1
Aug...	76	4,172,310	3,554,873	17.4	70	70,319	60,991	15.3

Mos.	Percentage of Installed Ratings Represented	Operating and Maintenance Expenses (Companies Reporting) 1923 Thousands of Dollars	1922 Thousands of Dollars	Per Cent Increase	OPERATING RATIO Steam Plants 1923	Steam Plants 1922	Hydro Plants 1923	Hydro Plants 1922	Combined Systems of Steam and Hydro 1923	Combined Systems of Steam and Hydro 1922
June..	58	28,016	23,749	18.0	50.2	54.2	28.0	26.4	43.7	44.9
July....	59	28,320	24,150	17.3	52.0	55.3	28.0	27.9	45.0	46.1
Aug...	59	29,797	26,024	14.5	53.1	55.8	29.1	29.2	49.3	49.3

Relative Safety of 440-Volt and 220-Volt Systems

IN THE article entitled "Steam Plant Auxiliaries," by C. G. Gray and M. M. Samuels, in the Oct. 13 issue of the ELECTRICAL WORLD, a few lines were accidentally omitted. At the top of page 751, in the left hand column, the article should read as follows:

"The apparatus available for 2,300 volts is safer than that available for 440 volts and less expensive for the same kva. because of the low amperage. Statistics seem to indicate that the percentage of accidents on 440 volts and the neighboring voltages is higher than on either much higher or much lower voltages, and the authors can testify from their own experience that in the majority of cases requiring resuscitation known to them the shock was caused by 440 volts or 550 volts alternating current. The most balanced system, therefore, seems to be one using 2,300 volts on all large motors and 220 volts on smaller motors which are not built for 2,300 volts, or where the cost of 2,300-volt starters would be too high."

New Solution of Power-Factor Problem

Account of an Interview with the Developers of the Fynn-Weichsel Motor, During Which Demonstrational Tests Were Witnessed and Observations of the Motor in Process of Construction Were Made

THE recent announcement by the Wagner Electric Corporation of a new adjustable power-factor polyphase motor having very desirable starting and running characteristics and the news article on this motor in the Oct. 20 issue of the *Electrical World* have caused so much desire among engineers to know further details that a representative of the paper paid a visit to the St. Louis factory of the company for the purpose of obtaining them. The construction of the motor in various stages of completion was observed, a demonstration of its operation under stipulated conditions was witnessed, and the general power-factor situation was discussed with W. A. Layman, president of the company; A. H. Timmerman, vice-president, and other members of the Wagner staff. An account of the observations made and the replies of the company's officials to questions asked them are printed here.

"ENGINEERS would like to know more about the construction of the new unity-power-factor polyphase motor which was recently announced by the Wagner Electric Corporation," said a representative of the ELECTRICAL WORLD a few days ago to W. A. Layman, president of the corporation, "because construction, as well as performance and cost, will largely determine their acceptance or rejection of the machine." "We shall be only too glad to show you the motors in various stages of construction and submit them to any tests you desire to make," Mr. Layman replied, "but we should prefer not to go into an elaborate engineering description of the motor at this time, since this is to be made the basis of an engineering paper in course of preparation by Mr. Weichsel for presentation to the American Institute of Electrical Engineers."

A walk through the shops with Mr. Timmerman and Mr. Weichsel disclosed the fact that the motor does not appear on first glance to be very different from other alternating-current motors. It has stator and rotor punchings of much the same construction as any wound-rotor motor. However, the stator has two windings, which may be of either concentric or distributed type (the first type is being used now). One winding, called the "starting winding," corresponds to the secondary of the usual wound-rotor motor, being connected during starting with external resistance which can be reduced and eventually short-circuited. The second winding, called the "operating winding," is displaced 90 electrical degrees from the first winding and is connected to brushes bearing on a commutator carried by the rotor. This winding carries the exciting current furnished by a commutated rotor winding and corresponds to the field of a synchronous motor.

The rotor also has two windings. One is a plain three-phase alternating-current winding which carries the load current, corresponding to the primary of a wound-rotor or synchronous motor, and is connected to slip rings. The other winding is very small, consisting of one or two turns per coil, placed in the same slots with the load winding, and is connected with the commutator to furnish exciting current to the "operating winding" on the stator. In general construction the motor is so closely analogous, both mechanically and in its windings, to construction of the older types of motors that assembly, winding and so forth, do not appear to entail much more of a job than in the case of an ordinary motor.

At this point the question was raised, "Will the user not experience commutator trouble?" It was very satisfactorily answered by the reply that the commutated current is only for excitation, the voltage being only 15 volts maximum. A demonstration later failed to disclose any sparking even when the motor was put through various antics such as starting and carrying 150 per cent of rating and even more. In fact, the commutator had a very desirable glaze on it. The slip rings carry all of the load current of the motor.

"The performance curves which were published in the ELECTRICAL WORLD of Oct. 20 should explain what the motor can do," admitted the ELECTRICAL WORLD representative, addressing Mr. Timmerman, "but what do you consider the outstanding characteristics of this motor?" "This motor has a combination of the good characteristics of slip-ring induction and synchronous motors," Mr. Timmerman replied, "with most of the undesirable ones eliminated."

OPERATING BEHAVIOR OF MOTOR

In explanation, demonstrations were made and results of tests shown which indicated that the motor starts in the same manner as a slip-ring motor. The starting current and torque were exactly similar. (See Fig. 1.) As indicated by the curves published Oct. 20 in the ELECTRICAL WORLD and demonstrated by test on this occasion, the motors are so designed that if the starting load does not exceed 125 to 150 per cent of rating the rotor will continue to increase in speed as a slip-ring motor, until very close to synchronous speed, when the commutated current from the "exciting winding" magnetizes the "operating winding" on the stator sufficiently to pull the rotor into step. It continues to operate as a synchronous motor until the load exceeds the synchronous pull-out value, which is about 150 per cent full-load torque. When this happens the motor automatically reverts to slip-ring induction-motor operation with about 3 per cent slip. If the load reduces again, the motor will automatically pull into step and operate at synchronous speed. This action was demonstrated by means of a stroboscope and instrument readings.

The slip is so small when the rotor pulls out of step and operates as a wound-rotor motor that the efficiency is not greatly affected, according to the test curves previously published. Of course, the line current is slightly affected when the motor changes from induction to synchronous action or vice versa, the variation being about 16 per cent. However, no motor can be expected to carry a load continuously which is hovering around this transition value. Most of these motors are de-

signed to develop 300 per cent full-load torque before they will stop entirely.

In the commercial design of the motor a wide range of power factor between unity and heavy leading values may be provided according to the conditions of installation. If a power-factor characteristic providing compensation for present lagging power-factor load is desired, the motor will be constructed to give heavy leading power factor; if for installation where no existing lagging load prevails, then the motor will be supplied to have virtually unity power factor at all loads.

"Is this motor a recent development or was it previously conceived and just announced as a commercially available machine?" Mr. Layman was asked. "We have been working in this field for many, many years," he replied, "but until a comparatively recent date the burden of poor power factor was not sufficiently appreciated by the distributing companies for them to be interested in the commercial development of a unity-power-factor motor. Then, too, the war, with the accompanying demand for quantity production of war supplies, sidetracked special development work, although power-factor corrective apparatus was even then greatly needed to release idle equipment for productive purposes. Since the war the conditions of the reconstruction period, while difficult, have permitted a resumption of development work, and this motor in commercial form is the fruit of the resumption of our development program.

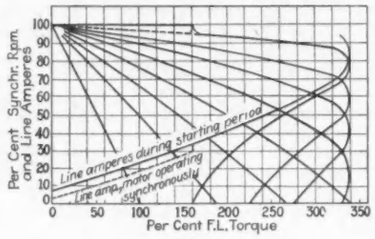


FIG. 1

Speed torque characteristics of 15-hp., 440-volt, three-phase, 60-cycle Fynn-Weichsel motor.

"Then, too, there has been a radical change in the central-station situation with respect to power-factor correction. Dating from the 1921 convention of the National Electric Light Association there has been a continuous and an urgent pressure from the Technical Section of that organization for the development of unity-power-factor motors, and the acceleration of our development program may be directly traced to this vigorous encouragement from that source."

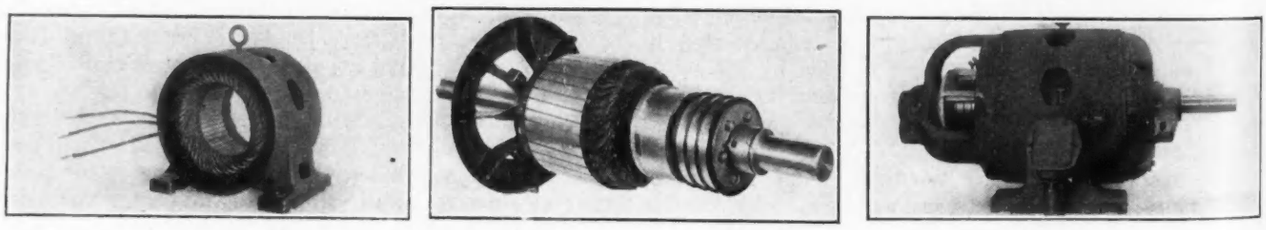
"Is the saving possible through power-factor correction really as stupendous as you were quoted as saying in the newspapers?" Mr. Layman was asked. As supporting evidence, he referred to a detailed study on one large utility company's system which had a peak load of approximately 269,000 kva. and 213,240 kw. The investment in generating stations was about $4,979,000, in transmission system about $12,270,000 and in distribution system about $27,123,000. The power factor of the transmitted load was relatively high, namely 79.3 per cent, while that of the distributed load was 72.7 per cent. Still, the energy losses due to power factor were 71,000,000 kw.-hr. per year out of a total energy loss of 269,000,000 kw.-hr. Evaluated at the low figure of 0.686 cent per kilowatt-hour, this meant a loss of $485,000 a year alone.

Looked at from another angle, the power factor required $3,576,000 more investment in generating and transmission equipment than necessary and $7,438,000 more in distribution, making a total additional investment of about $11,014,000, on which the fixed charges would be about $1,322,000 a year. Added to the total losses, the cost of low power factor was $1,807,000 a year or 19½ per cent of the total operating expense inclusive of fixed charges.

POSSIBLE SAVINGS BY IMPROVING POWER FACTOR

"These figures refer to only one system," Mr. Layman explained. "The total central-station investment in this country is approximately five billion dollars, and it will be noted that the total investment in this plant is less than 1 per cent of this total national investment. If the idle investment on the single system referred to is less than 1 per cent of the whole, and if it be assumed that the central-station industry as a whole is not operating under more favorable conditions than this one large unit, it will be seen that the broad statement made in some of the newspapers to the effect that there is a billion dollars of idle plant investment growing out of low-power-factor operation is not a wild flight of the imagination."

"While you advance good reasons why central-station executives should be interested in power-factor correction, how do you expect their customers to pay 25 to 35 per cent more for your motor than for a standard motor?" the ELECTRICAL WORLD representative inquired. Mr. Layman replied: "When the fundamental economic conditions so strongly cry out for a corrective device such as this new motor, it may be taken for granted that practical policies insuring its rapid adoption will be adopted by the industry. What these policies are to be with respect to central-station practice is naturally a question for time to determine. It is our anticipation, however, that the near future will see a definite clarification of policy with respect to this question on the part of central-station companies along lines which will offer an incentive to the employment of this new type of motor. Over and above any incentive the central station may offer, however, there exists right inside the industrial customer's plant an actual money saving which may be sufficient to justify the additional capital investment in the new motor as compared with the old. I refer to the excess of losses within a customer's own plant in transformers, switching devices, meters and



VIEWS OF FYNN-WEICHSEL MOTOR

At left, stator with its two windings; in center, rotor showing both slip rings and commutator; at right, assembled motor.

distribution wiring, growing out of the idle current flowing in the system; also to the lower operating efficiency of motors due to poor voltage regulation arising from excess loss of pressure in the distributing system.

"The additional cost of the new motor as compared with the old will be a relatively low price to pay for power-factor correction," continued Mr. Layman, "when means heretofore suggested are taken into consideration. It must also be taken into account that the corrective effect is applied by the new motor at the source of the trouble. This is not generally true with other means heretofore employed. So the operating savings are larger. The new motor involves no sacrifice of space, which will in many instances be an important factor, and does not in any way increase the chance of accident or injury to plant operatives over that with the older types of motors."

Power-Station Lighting*

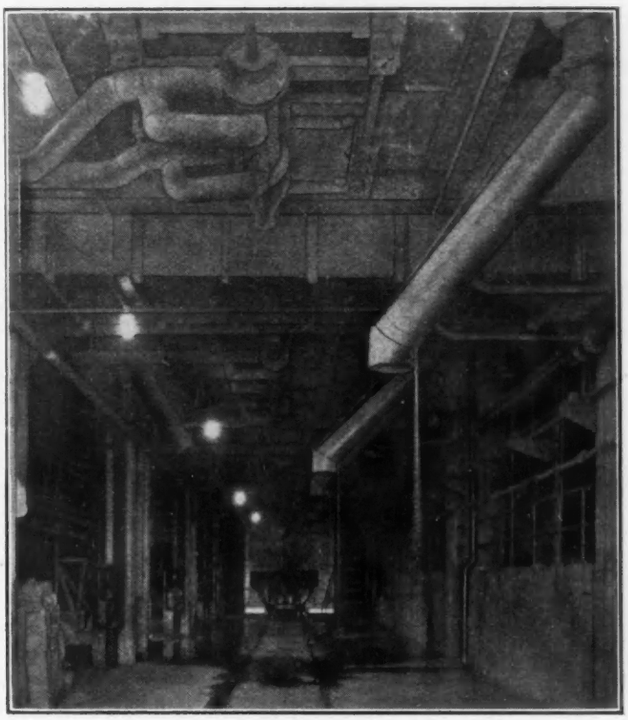
Recommended Intensities for Various Sections of Plant—Sources of Energy, Distribution System, Emergency Lighting and Equipment Discussed—Interesting Method of Lighting Water Column Described

By RAYMOND A. HOPKINS
Engineer, Stone & Webster, Inc., Boston

UNUSUAL problems are met in the lighting of power stations on account of individual arrangement of equipment, severe service conditions and exacting requirements. The successful lighting system must be reliable, economical, easy to maintain and adequately suited to the specific local requirements, which differ throughout the station. The most reliable and economical source of energy is usually the station auxiliary bus. The distribution wiring should be of the particular quality best suited to meet power-station conditions and should be designed to give the best possible voltage regulation consistent with economy. An emergency lighting system should be provided, and of several possible arrangements the one giving greatest dependability should be selected. All equipment, such as cabinets, switches, receptacles, lamps, globes, shades and reflectors, should be carefully selected to give maximum operating convenience, long life and high efficiency.

With regard to sources of energy, the main station bus in a direct-current station is generally the most reliable and economical source for the lighting and is usually chosen on this basis, although the voltage regulation may not be of the best. The main station bus in an alternating-current station is in itself a reliable source. When the potential of this bus is more than 2,300 volts, however, the transforming and switching equipment is expensive and also constitutes a possible hazard to the lighting system. Moreover, a voltage regulator is always required as the bus voltage may vary as much as 10 per cent above or below normal. The 2,300-volt station auxiliary bus, from which all motor-driven auxiliaries are fed, is usually considered the best source of energy for the lighting system. Since the continuous operation of the station auxiliaries is very important even under conditions of power interruption or voltage surge on the main bus, the station auxiliary bus is usually energized from at least two sources of energy, at least one of which is a prime mover. A voltage regulator is necessary only when the auxiliary bus for some reason does not carry a uniform voltage.

The storage battery is a most reliable secondary source, and with proper charging connections the voltage regulation is satisfactory. The cost of the battery and its poor efficiency prohibit its use for normal lighting, but it is very commonly used as a source of emergency lighting. When so arranged the battery size is determined by the demand of the emergency lighting system plus the demand of the control system. The latter is likely to be heavy during a period of emergency since at such a time considerable switching is done. A maximum allowance of one hour for demand on the emergency lighting system at any one time is considered ample to meet the most extreme condition. Since the control circuits constitute a very sensitive and important part of the station wiring, it is important that the emergency lighting system, if fed from the control battery, be kept free from grounds or other faults which may cause trouble with the controls.



EQUIPMENT ON CEILING OF ASH ROOM NECESSITATES SPECIAL LIGHTING LAYOUT

Important parts of the station to be covered by emergency lighting are water columns, boiler gages and

*Abstract of paper presented at the convention of the Illuminating Engineering Society, Lake George, N. Y., Sept. 24-28, 1923.

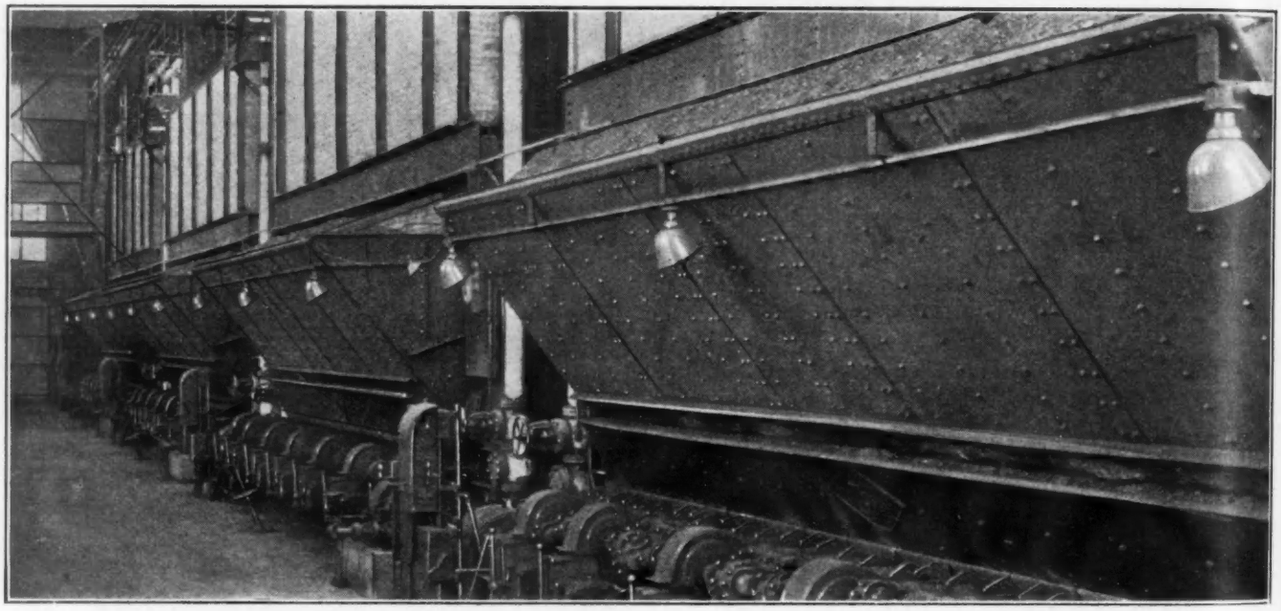
meters, stoker and fan controls, boiler-feed pumps, turbine gages and controls, turbine auxiliaries, valve controls, oil circuit breakers and disconnecting switches, lighting transformer and switch rooms, switchboard rooms, load dispatcher's office and all stairways and passages. The amount of lighting on the emergency system to be recommended is given in the last column of Table II.

EMERGENCY LIGHTING CONNECTIONS

There are three commonly used systems of emergency lighting connections. In each system the emergency wiring is segregated from the normal wiring by the use of separate conduits, cabinets and outlets. It is often found convenient, however, and perfectly satisfactory, to use combination cabinets with barriers separating the normal from the emergency circuits. The first system consists of a number of small auxiliary lamps arranged to burn normally and in emergency on the emergency source. Since the lamps are kept burning continuously and are always fed from the emergency source, the number and size of the lamps must be kept small so as to conserve energy. The lamps, therefore, cannot be used to supply any portion of the normal illumination, but must be considered as auxiliary or supplementary to the normal lamps. The emergency system, being supplementary to the normal system, is apt to be robbed of lamps and fuses and otherwise to become deteriorated, since under normal conditions its loss is not felt. The system, therefore, requires rigid routine testing and maintenance.

The second system consists of a number of small auxiliary lamps arranged to be normally dark but in emergency to burn on the emergency source. Somewhat larger lamps can be used than in the first system, since they burn only in emergency, but all gages and other vital points must have duplicate lamps. The main switch for the entire system consists of a contactor, normally held open by a potential coil energized from the normal source, but automatically closed by energy from the emergency source whenever the normal potential fails. This, being a supplementary system, requires the same rigid routine testing and maintenance as the first system.

The third system consists of a carefully selected portion of the normal lamps to be designated as emergency lamps and arranged to burn normally on the normal source and in emergency on the emergency source. The size and the number of lamps are only limited by the energy available at the emergency source for the short time that the emergency exists. Moreover, since the lamps burn normally on the normal source, no duplication of lamps is required at gages and other similar places. The main switch for this system consists of two contactors interlocked so as to form a double-throw switch. Normally the switch feeds the emergency lights from the normal source, but in the event that the normal source fails the contactor is automatically thrown over by energy from the emergency source so as to feed the lamps from that source. The action is reversed when the normal potential is restored.



ANGULAR REFLECTORS HUNG FROM HOPPERS ADEQUATELY ILLUMINATE STOKERS AND STOKER DRIVE MECHANISMS

In the distribution system special insulation is very desirable in boiler and condenser rooms where the wire is subject to conditions of severe heat and moisture. In these locations the ambient temperature is often above the safe temperature for rubber insulation, and escaping steam sometimes produces condensation which is liable to saturate the braid. Varnished-cambric insulation with lead covering is quite satisfactory but very expensive. The same insulation with braid covering gives very good results. None of the usual rubber compounds are suitable, but certain vulcanized compounds are available which are satisfactory for boiler-

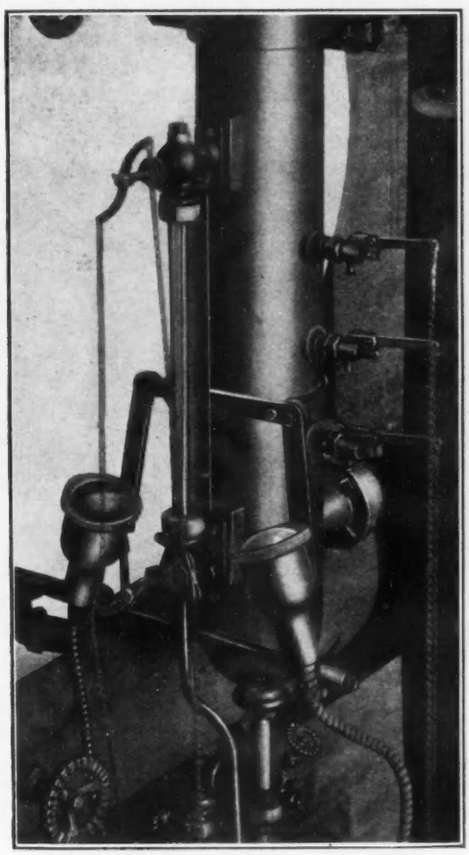
TABLE I—TYPICAL LIGHTING EQUIPMENT FOR A MODERN 100,000-KW. PLANT

	Boiler House	Turbine Room	Electrical Bay	Entire Station
Lighted floor area, sq.ft.	55,000	45,000	35,000	135,000
Number normal lights	300	250	400	950
Number emergency lights	120	50	140	310
Total number lights	420	300	540	1,260
Connected normal watts	31,000	49,000	33,000	113,000
Connected emergency watts	8,500	10,500	11,000	30,000
Total connected watts	39,500	59,500	44,000	143,000
Total watts per square foot	0.71	1.32	1.26	1.06

room use. Much trouble from excessive temperature can be avoided by carefully selecting the locations of conduit runs.

The intensity of the illumination for various sections of the power plant are given in Table II. The firing aisle is the most important part of the boiler house. Here are located the water columns, steam gages, draft gages and the controls for the larry, stokers, fans and auxiliaries. Normal lighting should be adequate for operation of the boilers both night and day, and the emergency lighting should be sufficient to allow full operation without normal lighting, which means that 25 per cent of the general lights and all of the local lights should be on the emergency system.

The water column, which is about 30 ft. above the floor but which requires constant watching by the operator, deserves very careful consideration. The



WATER COLUMN ILLUMINATOR THAT HAS PROVED ITS SERVICE

light should preferably be directed from below so as to avoid specular reflection from the gage glass. Moreover, the lighting equipment must be very rugged in order to withstand the severe force of an exploding water glass. Being arranged to face upward, it must have some efficient means of removing the dust which quickly accumulates. One type of water-column illuminator in which two beams of light from two 40-watt lamps are focused by the lenses to impinge on the meniscus of the water column and cause it to glow so that it can be readily seen from any part of the firing aisle has worked out very successfully. A series of small holes on the casing around each lens are arranged for connection to the station compressed-air system or to the forced-air duct, and the streams of air effectively prevent the accumulation of dust. This device has

TABLE II—RECOMMENDED LIGHTING PRACTICE FOR MODERN GENERATING STATIONS

	Intensity Foot-Candles Recommended	Energy Required, Watts per Sq.Ft.	Size of Lamp, Watts	Emergency Lighting, Per Cent of Total
Coal pile and yard	0.7	0.1	1,000	None
Roadways	0.2	0.03	200	..
Coal bunker and conveyor	2.0	0.5	75–100	15
Firing aisle	(See text)			
Between boilers	3.0	0.6	100–150	20
Over boilers	...	...	100	50
Ash room	...	...	100–150	15
Turbine room:				
Normal operation	4.0	0.5	750	50
For repairs	8.0	...	750	25
Condenser floor	4.0	0.75	100–150	20
Battery room	4.5	1.00	75	25
Bus room:				
30-in. horizontal plane	3.0	1.25–1.75	75	20
Face of bus structure	1.5			
Switch room:				
30-in. horizontal plane	4.0			
Front of cell top	2.0	...	50–100	30
Disconnecting switches	1.5			
Switchboard room:				
30-in. horizontal plane	3.5–8.0	0.75–3.5	75–100	30
On instrument scales	2.5–3.0			

proved its ability to withstand water-glass explosions. The steam gage, the clock and the load indicator should also be lighted from below, to avoid reflection. Excellent results are obtained by using a single 40-watt unit of the water-column illuminator just described. The gage board generally contains a group of indicators and gages and is successfully lighted by one or two 75-watt angular steel-reflector units. The stokers and drive mechanisms are generally placed under the hoppers. These are adequately lighted by 75-watt angular reflectors hung from the hoppers. The walkway over the hoppers and the tops of the hoppers themselves should be well lighted, since this walkway is provided for the use of the operator while inspecting the contents of the hoppers and breaking up masses of coal that may become clogged. Deep bowl or "RLM" units of 100-watt size are satisfactory. The larry requires one or more 75-watt deep-bowl or angular reflectors in the cab to light the controls and weighing scales. It is also desirable to supply one or two 100-watt angle-reflector units for each chute to light the end of the chute and the hopper during the dumping process. At the throat of the bunker one or more 75-watt reflector units may be used advantageously to assist the operator in opening the gates and discharging coal into the larry.

Census Bureau Issues Electric Railway Data

THE United States Census Bureau in announcing the result of its census of the electric railways of the United States, taken at the beginning of this year, brings out the fact that about 1,000 fewer miles of single track was operated in 1922 than in 1917. The miles of single track operated in 1922 aggregated 43,933.88 as compared with 44,808.31 in 1917 and 41,032.91 in 1912, showing an increase of 7.1 per cent for the ten-year period but a decrease of 2 per cent since 1917. These figures do not include electrified trackage of steam-railroad companies. The figures show decreases in track mileage in thirty-two states and small increases in sixteen states and the District of Columbia in 1922 as compared with 1917. The most important losses of trackage occurred in Massachusetts, 366.31 miles, and in Ohio, 260.27 miles. New York State leads in single trackage, with 4,792.35 miles, followed by Pennsylvania with 4,423.08 miles.

Significance of Electrical Shows

Observations on the Influence of the Modern Electrical Exposition and Opportunities It Brings

BY ARTHUR WILLIAMS
General Commercial Manager New York Edison Company

FOR many years—happily now in history—there has been some complaint, probably largely justifiable, that adequate opportunity is generally not given to the public and the customers of the utilities to become practically acquainted with the various electrical appliances and their applications, new and old, in our industrial and home life. A sense of the justice of this complaint was probably an important factor in establishing New York's Electrical Show as an annual event. Several electrical shows had been previously held, but they occurred at irregular intervals and seemed to fail in attracting any general support on the part of the electrical industry or any general interest on the part of the public. For these reasons the experiment of again undertaking this form of educational and co-operative publicity was ventured upon with hesitancy and some doubt as to its effectiveness. The results, however, have been most gratifying, both from an industrial and a human point of view, the show of this year being the sixteenth of the series. The character of the attendance indicates the extent of the interest, and the purchases made by the visitors would appear to testify to a larger degree of appreciation than in any preceding year.

VALUABLE CONTACT

It would be exceedingly difficult to set forth with any completeness the many and various relationships made possible through such a gathering as this. Summing up the exhibits from year to year, one cannot but be impressed by their manifold application, their symmetry of design and the ease with which they can be placed in the service of the consumer. Undoubtedly this result, at least in part, has followed the bringing together in former shows, and in close juxtaposition, of the developments in the product of each manufacturer —an association which has led to the rejection of the bad or half-good and the permanent adoption of the good or of the best observable features of each article or invention. Thus each contributes something to the common good.

Again, there is an undoubted advantage to the manufacturers and the representatives of the utilities in coming together on occasions such as this and in being brought jointly into contact with great numbers of an interested, appreciative public of consumers. It is an opportunity for a joint meeting between these three important interests which probably could be brought about in no other way. Nowhere else can be found such an aggregation of modern appliances and devices exhibited and demonstrated under the best physical and psychological conditions, together producing a mass effect which, taken alone by itself, is a very desirable kind of publicity. The *tout ensemble*, if I may use the term, is one which cannot do other than create a lasting and most pleasing impression in the minds of all visitors, to the distinct advantage of the exhibitor, the utility, the industry at large and the visiting public.

EDUCATIONAL INFLUENCE

A very important feature of the New York shows has been the opportunty they have afforded to co-operate with the educational authorities and to bring the utilities into very close relationship with public and private schools. A great many thousands of the older students come to the exposition each year as guests. and, in a short time and under very pleasant conditions, they obtain a degree of familiarity with the world's electrical development and progress possible in no other way. Just as in all general museum effort, in natural history and in art, actual contact with the thing itself is considered the most effective means of impressing the memory and broadening the understanding, so it is thought that visiting the Electrical Show makes a corresponding impression upon the minds of the students.

EXHIBITS IN THE 1923 NEW YORK ELECTRICAL SHOW WERE ATTRACTIVE AND EFFECTIVE FROM BOTH EDUCATIONAL AND SELLING POINTS OF VIEW

The students of today are the men and women of tomorrow upon whom our industry must depend for its larger and better growth. Without doubt the scholar-visitors to the first show of sixteen years ago are to be largely numbered among the appreciative consumers of today, either in New York City or elsewhere. Though not always recognized in such an aspect, the public utility is one of the most important factors of any community's larger progress; and, vice versa, all that benefits the community must be, at least in some degree, beneficial to the utility. There are no more important points of contact from the civic standpoint than are made possible through the joint effort of the educational authorities of the community

and the electrical industry in bringing the students of the city into practical relationship with the manifold exhibits contained in the show.

There is another relationship through which the New York shows have created a great deal of favorable comment—the extent to which they have been used by the federal, state and municipal governments to bring to the attention of the public some of their activities in the interest of the public service. Electricity plays a very important part in the work of the navy, the army, the Signal Corps, the Department of Commerce, and probably in every other government activity. The fifteen or twenty governmental exhibits of this year attracted an extraordinary degree of public interest. Such a combination of effort would probably not be possible without an occasion like that the show affords. It is true that these exhibits probably have no commercial value in the usual sense, but as a factor in establishing good will toward the utilities that make these exhibitions possible and the government agencies in which we are all so vitally interested, in showing to an important element of the community to how great a degree our government is making use of the facilities offered by electricity, the value in obtaining public appreciation and good will can hardly be overestimated.

Furthermore, the working exhibits of such an exposition permit a demonstration of the practical applications of electrical energy in the form of light, power and heat which, again, would not be possible through any other agency. There is practically unanimous interest on the part of the visitors in any automatic or manufacturing process placed on exhibition at the show. It would seem, therefore, that there can be no doubt regarding the educational and commercial value of any such exhibits.

A Supplementary Activity

It must not be thought that those in New York look upon the Electrical Show as a sufficient means of informing the public of the methods by which electrical service is placed at its disposal. It is but one of a series of efforts to arouse public interest and advance to the utmost the use of electrical energy and to create in general the favorable public opinion concerning electric service which all so earnestly desire. Thus there is nothing in the Electrical Show which takes the place of publicity efforts in the technical and general press, no substitutes for the displays maintained in various showrooms, nothing which lessens in any degree the utilization of the printing press in the various and ever-increasing ways by which it is an effective medium of communication and publicity. Instead of taking the place of these important agencies, it seems but to stimulate and enhance their use and value. However, it is undoubtedly true that the advertising of the show, together with the close contact that it makes with great numbers of people, does in itself produce a publicity which has great value of the industry.

In the last analysis, the permanence of the Electrical Show as a beneficial educational and publicity agency must depend upon the extent to which it appeals, interests and is of value to the people of a city. That it now forms an important part of local informing and publicity efforts in New York, that it is attracting very universal and favorable attention to the subject of electricity in its unlimited applications of a useful nature, there can be no question.

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

Effect of Daylight Saving Upon Residential Consumption

To the Editors of the ELECTRICAL WORLD:

In a paper presented before the American Institute of Electrical Engineers on Feb. 18, 1920, the writer made an analysis of records of certain light and power companies in the northeastern part of the country, indicating that when clocks were advanced by one hour in the spring and retarded by one hour in the autumn, seven months later, the effect upon the lighting load was of the order of 8 per cent. This was supplemented by a study of monthly output for one light and power company in residential districts, indicating for the whole daylight-saving period of seven months a reduction of the lighting load of the order of 6 per cent.

A report presented in September, 1923, by the committee on residence survey of the Association of Edison Illuminating Companies and abstracted in the ELECTRICAL WORLD of Oct. 6, page 708, shows average seasonal variation of consumption in medium-class residences taken from monthly bills in several cities in the northeastern part of the country. A curve is plotted showing monthly residential consumption for the seven months of standard time, and an independent curve is plotted for the five months of advanced time popularly known as daylight saving. The extent to which the two curves are offset at the beginning and the end of the daylight saving period is about 7 per cent. This figure would appear therefore to represent with fair reliability the extent to which advancement of the clock by one hour in the summer time diminishes the consumption of electricity in homes in this part of the country.

Electrical Testing Laboratories, New York City. PRESTON S. MILLAR, General Manager.

The Value of Standardization

To the Editors of the ELECTRICAL WORLD:

Standardization is looked upon by many as a check on progress, and in not a few instances it has so worked out in practice. However, it is not the unusual but the normal which should be considered as a guide, and standards are most appreciated by those who, having known of their advantages, no longer possess them. For example, the man who moves from one house to another and tries to use his reading lamp only to find that the plug does not fit the receptacle is instantly converted to the necessity of standardization of plugs and sockets. If, in addition, he discovers that his motor will not operate because it is wound for a different voltage or frequency, he may mutter some unprintable phrases about the public utility company which is a law unto itself. It is only through the use of unstandardized material that appreciation of the value of standards comes. We buy collars and shirts, shoes and stockings according to number or size and naturally expect them to fit. If they do not, the dealer hears from us and finds his goods on his hands again. Did like action follow the sale of all unstandardized electrical apparatus, the country would soon enjoy interchangeable material. J. S. SMITH.

Chicago, Ill.

Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

Roomy Design for Small Hydro Development

BY R. R. ROBERTSON

Assistant Engineer Bureau of Power and Light, Los Angeles, Cal.

THE usual practice in installing a vertical hydro-electric generating unit is to concrete the turbine casing in solid in order to support a concrete pedestal which in turn carries the weight of the generator above. Because of lack of room this arrangement usually results in great inconvenience when it is necessary to repair the turbine.

To get away from this cramped design the Los Angeles Department of Public Service in the construction of its San Fernando power plant laid out its turbine room as shown herewith. This plant contains two 3,500-kva. General Electric vertical turbine-driven generators rated at 4,400 volts, three-phase, 50 cycles, 500 r.p.m., driven by two S. Morgan Smith reaction-type turbines rated at 4,500 hp. each.

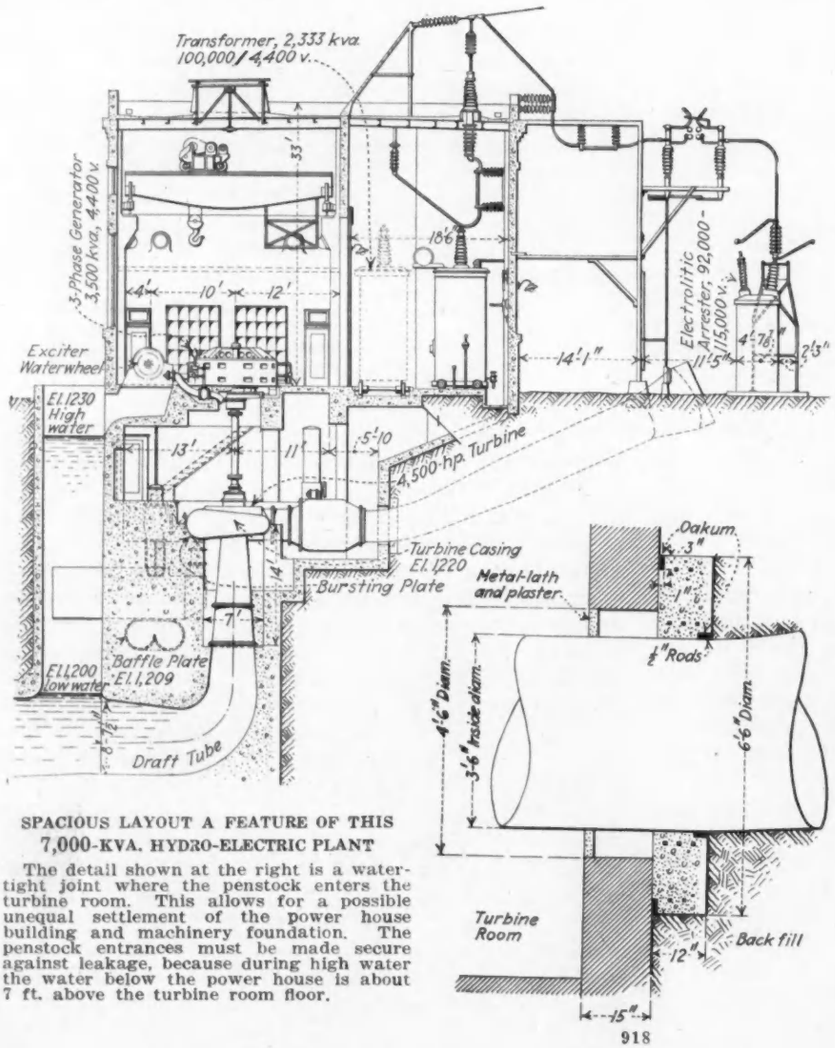
As will be seen by referring to the power-house cross-section, the turbine-room floor space is all available for use with the exception of the circular openings left for the purpose of getting at the turbine gate-operating mechanism. The turbine casing is not concreted in above its horizontal center line. This makes possible its complete removal if desired, simply by removing the nuts from the anchor bolts and disconnecting it from the draft tube and penstock. All pits in the turbine-room floor are covered by removable checkered-steel floor plates.

The generators and other equipment in the generator room are supported directly by the generator-room floor. This part of the building was designed with a system of beams, girders and column supports.

This plant has been in continuous operation at full load since its completion on Oct. 20, 1922. The foundation arrangement above described has given just as good satisfaction as have two other plants of the same system in which the equipment was installed in the usual way.

It will be noted from the power-house cross-section that there are two operating levels shown for the reservoir into which this plant discharges. The normal reservoir level is about as indicated as "low water 1200.0," but between the time the reservoir is filled to capacity and the time at which it is drawn down the water will stand very nearly at elevation 1230. This condition will put the walls of the turbine room under pressure from a maximum head of 7.33 ft. The only openings into the turbine room except from the generator-room floor above are where the two pressure pipes are brought in, so that these must be made secure against leakage.

In order to make a water-tight joint where the penstock enters the turbine room, and at the same time allow for a possible unequal settlement of the power-house building and machinery foundation, the pipe entrance was arranged as shown. The 12-in. x 6-ft. 6-in. concrete collar was put on the pipe the last thing before the backfill. The metal lath and plaster insert flush with the inside face of the wall was put in for the sake of appearance and also with the idea that any movement of the pipe with reference to the wall would be indicated by cracks in the plaster.



SPACIOUS LAYOUT A FEATURE OF THIS 7,000-KVA. HYDRO-ELECTRIC PLANT

The detail shown at the right is a water-tight joint where the penstock enters the turbine room. This allows for a possible unequal settlement of the power house building and machinery foundation. The penstock entrances must be made secure against leakage, because during high water the water below the power house is about 7 ft. above the turbine room floor.

Cable Entrances to Mines Require Good Design

BY W. E. BOYLE
Engineer, New York, N. Y.

WHAT is the best method of arranging cables from the generating transformer point before they enter mine shafts? Although this distance may be very short, here is a problem which needs close examination on account of the many possibilities of numerous faults.

When paper-insulated cables are buried in the ground there is continual danger from mechanical injury due to excavating, as this class of cable rapidly absorbs moisture. In most pit yards there are buried numerous steam and drainage pipes which heat the ground and keep the soil in a moisture-laden condition. On account of this fact the utilization of bitumen-insulated cables laid direct in the ground is virtually prohibited. The soil itself is liable to contain materials, such as ashes, which attack and corrode the armor and lead. Some of the methods by which this problem can be solved are given below:

1. The building of a culvert, say 2 ft. x 2 ft., from the power or transformer point to the edge of the shaft. This can be made of brick or cement, and a cover of boiler plating can be cut to size. The cables can then be cleated to the sides, a thorough draft for ventilation being assured.

2. The use of a catenary wire on which the cables can be suspended, thus always having them visible. This will eliminate all danger from steam pipes and acid-laden ground. A good covering is that made of lead sheathing and braided with waterproofed material. This lead sheathing forms an excellent protection against noxious gases. The width of the sling allows ample bearing surface and so protects the dielectric of the cable from damage due to lack of sufficient support. The hook and collar of the sling are made of galvanized steel.

3. The laying of the cable in iron, creosoted wood or earthware troughs on porcelain bridge pieces. The troughing is then filled with hot bitumen and covers made of the same material as the troughs placed in position. The final filling with the bitumen causes the covers to adhere.

Cleaning Transformer Cooling Coils

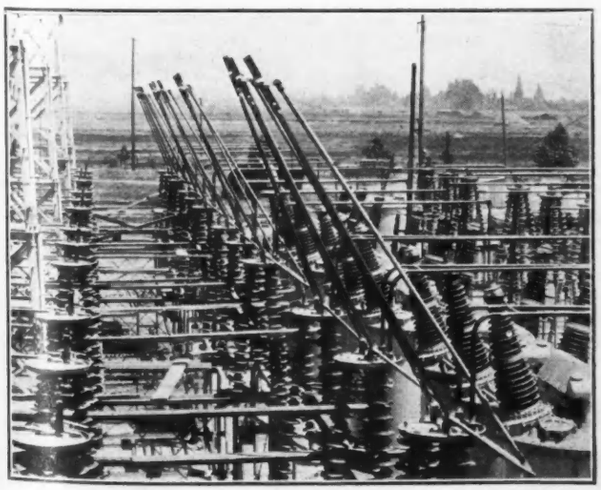
FOR the past year or so some trouble has been experienced with the water-cooling coils in the 25,000-volt transformers of the Pacific Power & Light Company at its Walla Walla (Wash.) substation due to the formation of scale. Soda and acid were used to clean the coils with but little effect. During the hot weather in July of this year the temperature rose to the danger point and it was necessary to do something to get more cooling water through the coils. They were taken out one at a time, and while a stream of water was passed through them they were tapped with a hammer. In this way two gallons of scale was washed out and about an equal amount of light material. After this treatment the discharge from the coils increased from 2½ gal. a minute to 15 gal. a minute.

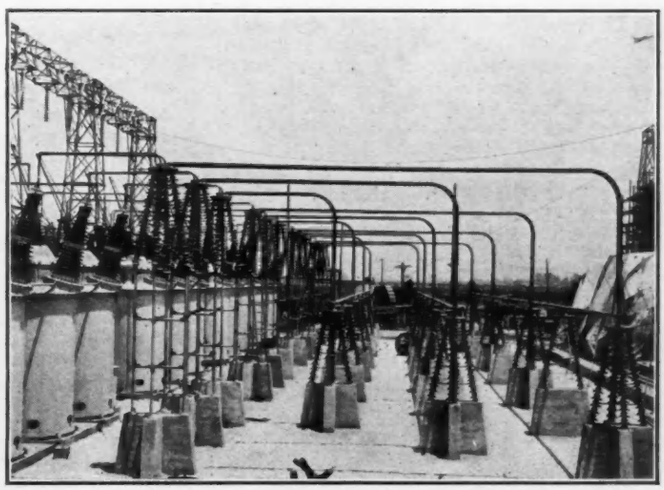
New Type of 220,000-Volt Bus Developed

INSTEAD of suspending the bus conductors from an overhead steel structure at the Laguna Bell 220,000-volt outdoor receiving substation, the Southern California Edison Company has developed the type of bus shown in the accompanying photographs. Four-inch wrought-iron pipe mounted on supports made up of pillar insulator posts is used for the conductors. This type of bus has an advantage in that it simplifies construction and in case of a flashover there is no overhead steel work to which the arc can travel.

The bus is supported by quadrupedal insulator supports which are spaced 45 ft. between centers. In the center between these supports are bipedal insulator supports all of which are set in concrete foundations. The take-offs are on the top of the quadrupedal supports. There are fourteen insulators in each stack and the stack is about 7 ft. high. The distance from the ground to the switch cross-overs is about 23 ft. There are cross ties bracing the supports after every third insulator. The spacing used between the legs of the bus is 11 ft. 9 in. between centers. The ground clearance is 12 ft.

To care for the expansion of the 4-in. pipe the center line of the bus saddle and the pedestal clevis should coincide at 70 deg. F. At the west end of each bus the bus saddle is fastened to the pedestal clevis so that it will not move, thus leaving the outer points of support free to expand and contract.





THE 220,000-VOLT LAGUNA BELL SUBSTATION OF THE SOUTHERN CALIFORNIA EDISON COMPANY

Left — Special-type disconnecting switch developed for 220,000-volt operation. Right —General view of the bus with oil switches showing at the left. In the foreground may be seen the type of support used at points where the leads top on to the bus. Each leg in these supports is made up of fourteen standard pillar insulator units topped by a piece of metal serving as a corona shield.

Estimating the Cost of New Substation Facilities

THE Gardner (Mass.) Electric Light Company distributes energy purchased from the New England Power Company from a substation having a present capacity of 4,875 kva. in two transformer banks. The load has already reached 4,700 kva., and with the early addition of 450 kva. from new customers and an expected 10 per cent increase in load from old customers amounting to 220 kva. the total aggregate load will shortly reach about 5,500 kva. This and further increases in load the company expects to handle by the installation of a bank of three 1,250-kva., 66,000/15,000/2,400-volt transformers at an estimated cost of $44,935, or $11.90 per kva. The itemized estimated cost is given in the accompanying table.

INCREASING SUBSTATION FACILITIES COSTS $11.90 PER KVA.

Three 1,250-kva. transformers (66/15/2.4 kv.)	$19,440
One 70,000-volt KO-36-A oil switch.	6,480
Two 70,000-volt air-break switches..	1,080
Disconnecting switches	432
Foundations	1,620
Pole structures	540
High-tension wiring and installation	4,320
Water piping	1,080
Remodeling of buildings	1,620
Converting 70,000-volt arrester to outdoor type	540
Temporary work	512
Conduit and control cable	810
Switchboard	540
Wiring for 2,300 volts	1,296
Field superintendence and tools	540
Engineering administration and general expense, 10 per cent	4,085
Total	$44,935
Per kva.	11.90

Extracts from an Operating Code*

High-Tension Testing

IT IS just as important to make the test for foreign voltage before proceeding with certain of the high-tension tests as it is in the case of the low-tension tests, because the preparation for these tests requires direct handling of high-voltage conductors by the operator.

Equipment

1. *Testing Equipment.*—Voltage for making high-tension tests is supplied either directly from a generator or from a testing set. The testing sets which are used for insulation and ground tests consist of transformers, a manually controlled indicating regulator and test leads. These sets are of two types, one in which the high-tension transformer is a two-phase transformer and the other in which the high-tension transformer is a three-phase transformer.

The test leads consist (a) of buses so arranged that any lines or generators can be connected to the bus and so that the test set can be connected to the bus, all these connections being made by means of disconnecting switches; (b) of insulated cables wound on reels and mounted on an iron framework so arranged that the testing cables may be unwound to reach from the test set to the apparatus to be tested.

2. *Equipment for Determining Phase Relation of Lines.*—This equipment, where installed, consists of synchronizing lamps or synchroscopes so arranged that they may be plugged in on the particular lines or apparatus. In locations in which this equipment is not installed phase tests are made by putting the apparatus to be synchronized on a dead bus and phasing it against an operating generator.

3. *Bus Grounding Equipment.*—In some locations bus grounding equipment is supplied on the main and test buses. This equipment consists of three fuses which may be connected between the individual phases and ground. These fuses can be short-circuited by disconnecting switches. The fuses are also arranged so that, when they are disconnected from the phases, they rest in contact clips which connect the fuses in series with incandescent lamps; if the fuses are continuous, the lamps will light when the circuit is energized from a grounded source of potential.

*Abstract from the operating code of the Philadelphia Electric Company.

Operations in General

1. Operators must keep away from equipment being given high-tension tests.

2. When making high-tension tests upon any station equipment, under no circumstances should the apparatus which connects the equipment to the test set be subjected to a higher voltage than that which would be used if the connecting apparatus itself were being tested.

3. While a high-tension insulation test is being made, the operator should observe the apparatus from a safe distance for visible or audible static.

Line Insulation and Ground Test

1. Make the test for foreign voltage.

2. If foreign voltage is indicated, report it to the load dispatcher and proceed no further until directed by the load dispatcher; then repeat the test for foreign voltage.

3. If no foreign voltage is indicated, connect the leads of the high-tension set to the conductors of the line and ground the A lead.

4. With the regulator adjusted to give minimum voltage, close the oil switch of the test set.

5. Slowly raise the voltage to the value specified by the load dispatcher, unless an excessive value of current is obtained at lower voltages, in which case stop the test and consult the load dispatcher.

6. Maintain the test voltage for one minute.

7. Reduce the voltage to a minimum and open the oil switch of the test set.

8. Disconnect the ground from the A lead.

9. Ground the C lead.

10. Close the oil switch of the test set.

11. Slowly raise the voltage to the value specified by the load dispatcher, unless an excessive value of current is obtained at a lower voltage, in which case stop the test and consult the load dispatcher.

12. Maintain the test voltage for one minute.

13. Reduce the voltage to minimum and open the oil switch of the test set.

14. Disconnect the test set leads from the conductors of the line.

Line Phase Test

1. The line to be tested must be connected at one end (the receiving end, when possible) to a source known to be in synchronism with the bus against which the line is to be synchronized. If the other end of the line does not extend to the synchronizing station, it must be connected through an intermediate station by separate buses and lines to this point.

2. At the synchronizing station connect the synchroscope and synchronizing lamps between the line and the bus. Proper phase relation is indicated by zero reading on the synchroscope and by the lamps remaining dark.

Transformer Insulation and Ground Test

1. Ground the secondary of the transformer bank as follows, with a wire no smaller than No. 12:

(a) 66,000/13,200-*Volt Transformer Banks.*—If energized from the 66,000-volt side, ground the B lead; if energized from the 13,200-volt side the 66,000-volt side need not be grounded.

(b) 13,200/6,000-*Volt Transformer Banks.*—If energized from the 13,200-volt side, ground the B lead; if energized from the 6,000-volt side the 13,000-volt side need not be grounded.

(c) 13,200/4,800-*Volt Transformer Banks.*—These shall be energized only from the 13,200-volt side and the neutral of each transformer winding shall be grounded, unless already connected to the system ground.

(d) 13,200/2,400-*Volt or* 6,000/2,400-*Volt Transformer Banks.*—These shall be energized from the high-tension side of the transformer only and the B lead of the transformer bank shall be connected to ground.

(e) On rotary-converter transformer banks the secondaries of which are connected delta or double-delta insulate all the alternating-current brushes from the rings and ground the B lead of each delta at the transformers.

(f) On rotary-converter transformer banks the secondaries of which are connected diammetrically two-phase or six-phase insulate all the alternating-current brushes from the rings and ground one terminal of each transformer at the transformer.

(g) On transformer banks whose secondary voltages are different from those specified ground connections shall be made according to the type of winding, as specified above.

2. Connect the transformer bank to a separate high-tension bus and line.

3. Test the transformer insulation from the generating station by applying a "line insulation and ground test."

4. Disconnect the transformer from the separate high-tension bus and line.

5. Remove the ground from the secondary of the transformer bank.

Transformer Phase Test

1. Connect the high-tension side of the transformer to a separate high-tension bus and line extending to the synchronizing station.
2. Energize the transformer from the low-tension side from a source in synchronism with the bus against which the transformer is to be synchronized.
3. At the synchronizing station connect the synchroscope and synchronizing lamps between the bus and line. Proper phase relation is indicated by a zero reading on the synchroscope and by the lamps remaining dark.

Reconstructing 60-Kv. Line for 110-Kv. Operation

BY E. S. BUNDY

Electrical Engineer Niagara, Lockport & Ontario Power Company, Buffalo, N. Y.

A SINGLE-CIRCUIT, 66,000-volt steel-tower line has recently been rebuilt and converted to a double-circuit line insulated for 110,000-volt operation by the Niagara, Lockport & Ontario Power Company. The line, 62 miles in length, was built in 1907 and consisted of square towers on concrete foundations, spaced on an average 550 ft. apart. The three power cables of 214,000 circ.mil seven-strand aluminum were mounted on pin-type insulators and steel pins, two pins on the cross-arm and one pin on the tower top giving a 7-ft. triangular spacing. The towers were of heights varying from 35 ft. to 75 ft. and were arranged for double-pin or single-pin construction, the double-pin construction being used on guyed towers where dead-ends occurred. All sharp angles were made by using three towers, two as dead-end towers and one between supporting two slack spans of approximately 100 ft. each.

The reconstructed line consists of two circuits of 336,400-circ.mil steel-reinforced aluminum cable mounted on suspension insulators, seven in a string on suspension towers and nine in a string on strain towers. New towers, ninety-seven in all (see accompanying table), were installed at all dead-end points, railroad crossings, angles and at one-mile intervals in straight sections of line. The new towers were installed on the old foundations where possible and guyed with ¾-in. galvanized-steel guy wire. New foundations were installed for all railroad-crossing towers and at other points where, owing to angles, etc., the location of the new towers had to be changed, or where unusual strains made larger foundations necessary.

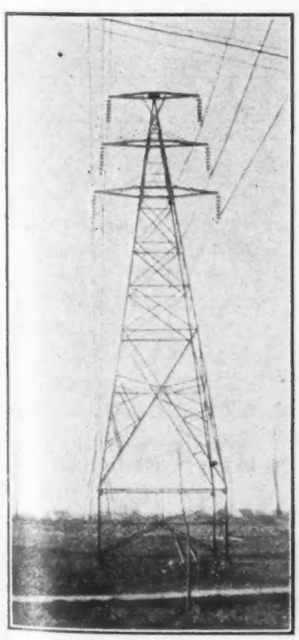
The reconstruction of the old single-circuit towers to take two suspension-insulator circuits consisted in installing three double-channel iron cross-arms as shown in the illustrations. The installation of three arms for two circuits made it necessary to raise a great many of these old towers on extensions in order to maintain the proper ground clearance.

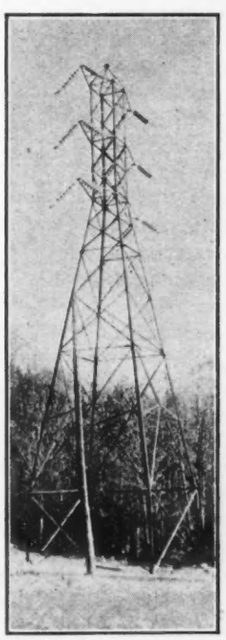
The line in general paralleled a branch railroad, making it possible to have the material shipped so that the average haul to the tower locations was approximately 3 miles. One crew took care of checking the material as received and delivering to the tower locations. An average weight of 1½ tons of material, which included steelwork, insulators, clamps, etc., was delivered to each location.

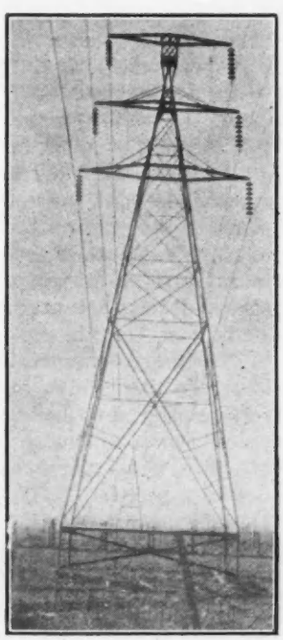
The construction work was divided between two main crews, with one crew working from each end toward the center of the line. Each of these main crews, under a general foreman, was divided into several

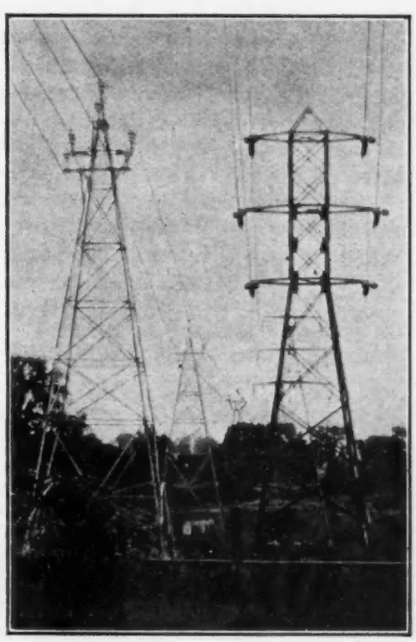
RECONSTRUCTED TRANSMISSION LINE OF THE NIAGARA, LOCKPORT & ONTARIO POWER COMPANY

The illustration at the right shows the tractor arrangement for pulling cables. The three old wires were pulled out at the same time as the new ones were pulled in, the latter being attached to the former. The illustrations below from left to right show a 57-ft. tower on a 10-ft. extension, a 52-ft. 6-in. semi-strain tower, a 49-ft. tower on 5-ft. extension and a 57-ft. tower of original construction and new railroad crossing tower on the reconstructed line.









smaller crews, each under an assistant foreman. These smaller crews were for excavating and foundations, new tower erection, extension erection, cross-arm erection, cable stringing and cable clamping. The crews went over the line in the above order, each doing its part of the work. The excavating and foundation crews put in all new anchors and foundations. The new tower erection crews took down the old towers at dead-end points, etc., which were to be replaced and then erected all new towers.

The extension erection crews erected all 5-ft. and 10-ft. extensions under the old towers. This work was done before the old cables were removed from the towers, which eliminated the necessity of temporarily guying the towers in the direction of the line. To install the extensions two gin poles with chain hoists were used, one on each side of the tower. The towers were guyed with rope at right angles to the line and raised vertically to the required height, after which the extension was assembled and bolted. One foreman, two linemen and four groundmen with one team could make an average progress of two extensions a day.

The cross-arm erection crews took off the old insulators, pins and arms, erected the new arms and hung the new insulators. They also hung the six 10-in. wooden-roller snatch blocks to the arms for stringing the new cable. One foreman, four linemen and four groundmen could average four towers per day.

The aluminum wire as received was in lengths of approximately a mile. Twelve reels of cable were set up at intervals of two miles and six wires pulled each way. The three old wires were pulled out with the tractor arrangement shown and three of the new wires pulled in at the same time, the other three wires on the other side of the tower being pulled in with teams. The cable crew also made up the compression joints between lengths and took up any great amounts of excess sag.

The cable-clamping crews pulled the cable to sag, made up the clamps and took down the snatch blocks, leaving the section of line ready for service.

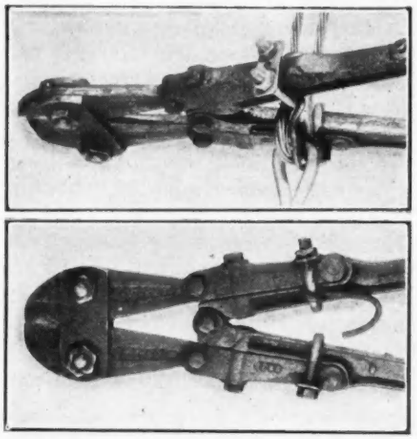
CONSTRUCTION NECESSARY IN CONVERTING 66,000-VOLT LINE TO 110,000 VOLTS

Old towers removed from line	186
Old towers moved to new locations	11
New towers:	
Railroad crossing	14
60-deg. angle	29
Dead-end	17
Semi-strain	37
Total new towers	97
5-ft. extensions	138
10-ft. extensions	81
Cross-arm attachments on old towers	539
New foundations	46
New guy anchors	111

Clamps and Thimbles Easily Attached to Guy Wire

BY E. O. KEATOR
Consulting Civil Engineer, Dayton, Ohio

BY THE use of the simple bolt-cutter attachment shown herewith guy clamps may be applied to guy wires in an easier, quicker, less wasteful and less destructive manner than by the usual method. Usually when choosing a guy, a cable longer than necessary is selected to obtain a long loop at the anchor eye, for, with a full tension on the drawing-up block and tackle, it is impossible to draw the two parts of the guy wire together sufficiently to apply a clamp. With a long loop it is possible to draw the cables together with the handles of the pliers or splicing tool if the tool is applied as far as possible from the anchor eye. The clamp is then put on and driven down against the anchor eye with a hammer. Driving destroys the galvanizing and the distance driven represents just that much wasted cable.



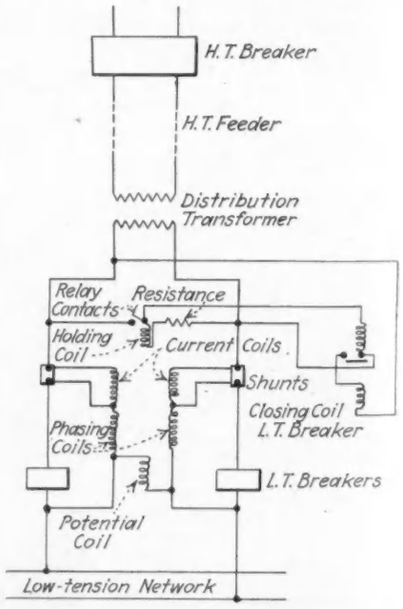
BOLT CUTTERS EQUIPPED TO DRAW CABLE TOGETHER FOR APPLYING CLAMPS

The improved method is as follows: To the handles of the bolt cutters apply two U-bolt clips as illustrated, and to one of the U-bolts attach a hook, the hook being bent out of a piece of ⅞-in. or ¾-in. rod. No other equipment is needed. The hook is inserted in the eye of the anchor rod and the cutter handles can now be used to draw the cables together so that the clamps can be applied to their permanent position against the thimble without hammering. The leverage obtained with the long handles of the bolt cutters makes it easy to draw the cables together no matter how tight they are. The U-bolts prevent the cables from turning in the handles when pressure is applied, and the hook attached to the anchor eye prevents the nippers from slipping up the cable as is the tendency when the cables are bent around the thimble. The clamp can now be applied directly against the thimble.

Protectors for Isolating Lines in Network

FOR promptly isolating an individual line feeding into a network an automatic network protector shown schematically herewith has been developed according to the 1923 report of the N. E. L. A. electrical apparatus committee. This device has the following characteristics: (a) In event of reverse power, such as a fault on the high-tension feeder system, the low-tension breaker will open, and (b) the breaker will close automatically when conditions on the low-tension side are corrected.

The reverse-power protection is so sensitive that the breakers of each feeder open when the feeder switch is opened at the substation and close when the feeder switch is closed. This affords a means of disconnecting distribution transformers feeding the network during light-load periods.



AUTOMATIC NETWORK PROTECTOR FOR ISOLATING DEFECTIVE LINES

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Linking Public Relations and Sales

How the Commercial Organization and Sales Service Program of the Pacific Gas & Electric Company Operates Under Joint Supervision

By Don C. Ray
Manager Bureau of Public Relations,
Pacific Gas & Electric Company, San Francisco

COMMODITY sales are a vital factor in the success of all industry. The disposition of a commodity, however, is poorly made unless it has been sold with a view of rendering a real service to the consuming public, and upon the degree to which the public is adequately served depends the future progress of the industry. Service and sales are therefore interrelated and interdependent, and their development will best be accomplished when due recognition is given to that principle.

The formulation of the service sales program of the Pacific Gas & Electric Company as now in effect contemplates an orderly and definite plan successfully and speedily to accomplish one main objective—the maximum use and value to the consumer of the commodity served.

Many companies have established separate departments for the purpose of telling the company's story of its operations and selling its service message to its customers. These departments are of increasing importance and the scope of their work is rapidly broadening. Very logically such work falls into the sales category and in this company is directed by the vice-president in charge of sales. Such a department, organized and functioning under R. E. Fisher, vice-president in charge of public relations and sales, has made notable progress in the furtherance of public relations and has in addition made each employee of the company feel that he individually is responsible for the success of the entire department.

The program is predicated on enlisting the earnest support and co-operation of all those whose assistance is necessary to its successful accomplishment. This is outlined in the nature of self-interest appeals to the various component factors involved, namely, the employee, the stockholder, the consumer, the dealer and the public.

The employees of any industry, when properly educated and instructed, constitute a very important and tangible asset. The employee's attitude when meeting the customer or public reflects, or should reflect, company policies and provides the most direct expression of those policies. The importance, therefore, of a proper attitude on the part of the employee is paramount. It is obvious that if the employee is to perform his full function in this respect, he must be kept fully conversant with the company's basic aims and objects. It is the company's responsibility to see that this is done, and a brief description of the general plan followed is outlined herewith.

ANNOUNCEMENT of the Pacific Gas & Electric Company's consolidating the supervision of its public relations and sales activities under the direction of a vice-president in charge of public relations and sales was made in the *Electrical World* of Aug. 11. In this article Mr. Ray now tells how the commercial program has been worked out and put into practical operation under the new plan of organization.

The practice of the company in performing this responsibility has been by means of short addresses by a competent company employee presented at group or sectional meetings of the Employees' Association, an organization 6,000 strong. Some idea of the character of the addresses may be had from the following list of subjects:

1. "Definition of Service."
2. "Fundamental Company Policies."
3. "Value of Courtesy."
4. "Proper Use of Telephone."
5. "Relation of Service to Good-Will."
6. "Advertising Value of Employee Contact with Consumer."
7. "Sales Possibilities of Employee."
8. "Ownership of Company Securities."

At the conclusion of these short addresses, the meeting is conducted as an open forum for a full discussion of the subject presented. The employee is impressed with his importance in the company organization and is encouraged to give complete expression to his individual views. As indicative of this the following pledge is suggested to each employee:

"I am at all times the individual personal representative of and for this company, regardless of my department or duties, and it is for me to see that the policy of this company—that of rendering service in its broadest sense—is carried on."

Each regular employee of the company is provided with a complaint and "prospect" booklet to be carried with him at all times and to be used for the purpose of reporting promptly to the interested divisional office any complaint or prospective business which may come to his attention in his contact with the customer. The complaint or "prospect" slip is signed by the employee and provides a record by which the activity of any particular employee may be appropriately acknowledged. All slips forwarded are at once referred to either the service or sales department, as the case may be.

Appeal to Stockholders

District stockholders' meetings at all central points on the company's system are held from time to time. Altogether about twenty-four of these meetings have been conducted. They are addressed by officers of the company, who present a general report on the company's activities, its accomplishments and its problems. The stockholders are urged to offer constructive suggestions and criticisms concerning the conduct of the company's affairs.

All stockholders are placed on the mailing list for the company magazine, a copy being forwarded them each month. In addition to this, they are from time to time circularized with informative literature pertaining to the company's activities.

APPEAL TO CONSUMER

All large customers are being circularized with a letter expressing the company's appreciation of their business, defining the service of the company in its largest sense and calling attention to the engineering service which the company maintains to enable them more efficiently to utilize its commodity.

Return postal cards are mailed to all customers, the return addresses being to the local divisional office. The following appears on the body of the postal card:

> We appreciate the opportunity of serving you, and it is our constant endeavor to make that service as nearly perfect as possible. If we have not fully accomplished this purpose, you are urged to make reply to the questions appearing on the return postal card attached and mail it promptly to this office. Either complaint or request, or both, will receive our best attention.

This card is signed by the local division manager. On the reverse side of the postal card the following questions appear:

1. Is the service being rendered you by this company satisfactory? If not, what suggestions have you for its improvement?
2. Have you made any complaints of our service that have not been given prompt and proper attention?
3. In dealing with you are all our employees courteous?
4. Do you desire any information concerning the various applications and use of our commodities?

Space is provided for the name and address of the customer. Replies to these postal cards are promptly referred to the interested department, and special attention is given to any requests or complaints received. A complete record of all postal cards issued and replies, complaints and requests received is kept in the various divisions and a monthly report forwarded to the head office.

APPEAL TO DEALERS—INDUSTRIAL CO-OPERATION

The appeal to dealers is generally carried on through organized societies in the industry. By constant contact with those organizations they are kept advised of the company's policies as affects their particular needs. The representatives of the company meet with these respective organizations from time to time for the purpose of discussing any problems which may be of mutual interest. It is felt that it is only through free discussion of such problems that the fullest measure of service will redound to the public. Most encouraging results are secured through this co-operation.

A definite "tie-in" is maintained with the California Electrical Co-operative Campaign in its various endeavors for educational plans, such as the traveling show-window lighting exhibit, electric homes, public-school film exhibit, convenience-outlet campaign, demonstrations, etc. The results of this tie-in are obviously good.

Contact is also maintained with business organizations and associations, farm bureaus, etc. This contact includes presentation of lectures and educational talks regarding the company's properties and problems. These contacts have been instrumental in acquainting a large number of consumers with the company's policy and with the organization it has provided to serve the public.

APPEAL TO PUBLIC

Display advertising is carried in a large number of publications in the territory served. The advertisements consist of institutional and sales advertisements the character and nature of which it is not necessary to mention here. Demonstrations at representative fairs and expositions are maintained in addition to those carried on continually in the various divisions of the company. These demonstrations are primarily for the purpose of effecting sales, but are designed in such a way that a message of service is conveyed to all of those attending. A very large number of customers and the public are reached annually through the medium of those demonstrations, and their effectiveness from a standpoint of both service and sales is apparent.

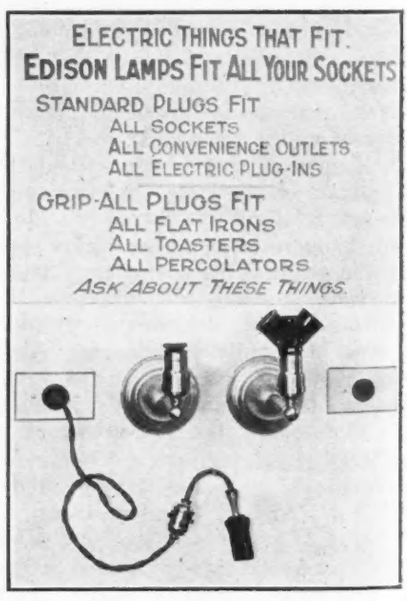
Educational trips to company properties have become a regular feature of company activities. A large number of customers and representative men in all lines of business have been afforded the opportunity of first-hand observation of the company's properties and organization.

Unquestionably the magnitude of the various company developments is by this method much more easily comprehended, and the visitor almost invariably attains to a better realization of what the public utility companies have actually accomplished and the important part they are taking in the industrial development of the community.

This, in brief, is the outline of the service sales program of the Pacific Gas & Electric Company. No illusions are harbored that it is either perfect or entirely original. Modifications and expansion have been and will continue to be made as experience may dictate. Fundamentally, however, the plan is sound and its practical operation to date has clearly demonstrated the many advantages derived and possible of attainment in its careful and continuous application.

Interfitting Plugs and Sockets Illustrated

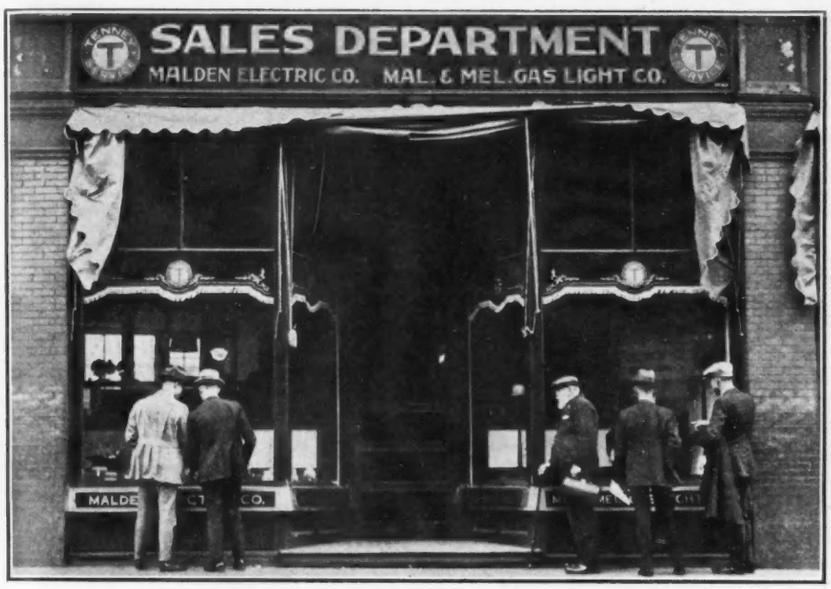
AT THE community electrical expositions being conducted in various suburban territories by the Edison Electric Illuminating Company of Boston an attractive display of interfitting plugs and outlets has been included under the supervision of R. S. Hale, superintendent of the company's special research department. The extent to which standard plugs now fit all sockets, convenience outlets and electric "plug-ins" is not appreciated by a large number of persons, who are also unaware of recent advances in plug design for use with electric tableware. The exhibit has aroused much interest among those attending the shows.



PLUG AND SOCKET DISPLAY SHOWS TREND TOWARD STANDARDIZATION

Central Station Separates Salesroom from General Office

SEPARATION of appliance sales activities from the main offices of the Malden (Mass.) Electric Company and affiliated gas companies has recently been effected with marked success. These companies serve an important suburban area north of Boston and have long been noted for their progressive management. The new sales department is housed two doors west of the main offices, and, as the accompanying illustration shows, it emphasizes the sales feature of the companies' activities instead of being classed as an appliance department only.



STORE USED EXCLUSIVELY FOR SALES PURPOSES

The new department occupies a floor area about 104 ft. x 30 ft., in addition to a commodious basement. Two show windows flank the entrance, which leads directly into an appliance display and supply service room about 84 ft. x 30 ft. in dimensions. At the rear is an office for the sales manager, and behind this is a consultation room, 20 ft. x 30 ft., with excellent facilities for salesmen's and demonstrators' meetings. In the basement are an appliance stockroom and repair division, offices for the local power engineer and service department, quarters for the advertising department and lockers for the use of appliance salespeople.

Compartments and drawers for the storage of domestic lighting supplies are built at one side of the room, with a convenient counter carrying outlets for lamp testing, an indicating meter showing the cost of operating appliances per hour, and facilities for clerical work. An extensive card index of customers and buildings is maintained, showing the names and addresses of occupants not having different types of appliances as well as those with known connected equipment. These "negative" cards are classified according to streets and are a great convenience in campaigns and drives on particular types of appliances. Appliance repairs are billed to customers, but repaired appliances are delivered from the sales department free and at the earliest feasible hour after their completion.

H. J. Walton, sales manager of the company, states that since the Malden sales department was opened a few weeks ago the public has taken most kindly to the idea of transacting all its appliance business at the new store instead of at the main office, and that the total number of visitors per day is larger than was the case when this department shared the office quarters of the Malden companies.

Georgia Railway & Power Territory in Relief

A LARGE relief map of north Georgia has just been made for the Georgia Railway & Power Company of Atlanta, showing the availability of abundant hydro-electric power for use of the industries in that section, where the company has during the past few years invested several million dollars in developments along the Tallulah, Chattanooga and Tugalo Rivers. The area covered is approximately 72 square miles, and the actual development already carried out produces hydro-electric energy which serves fifty-two municipalities and operates a majority of the industries in the district. The relief map was made to form a part of the company's exhibit at the International Textile Exposition, which opened in Boston on Oct. 29.

The exhibit itself, constructed in Atlanta, is a "live model," running water being used in the streams and electric lighting so used as to give an artistic and graphic effect. It is scaled one square foot to the square mile, thus being 72 sq.ft. in size.

What Other Companies Are Doing

Racine, Wis.—As a convincing index of the extent to which the Wisconsin Gas & Electric Company's business is growing in this city, this company will spend $4,500 to remodel the building immediately adjoining its present cramped office quarters, thus providing accommodations for more extensive sales facilities that have been imperative for some time. This improvement will not interfere, it is stated, with the company's contemplated plan to erect a new five-story office building on the present site.

Georgia.—Though authorized recently by the Georgia Public Service Commission to increase its rates for power and lighting, the Ware County Light & Power Company, Waycross, Ga., will not put the increased rates into effect, according to an announcement by R. E. Trexler, assistant treasurer of the company. Power company officials are inclined to the belief that this action establishes something like a precedent in Georgia public utility circles.

Boston, Mass. — Twenty lighting surveys in small stores made within a month by the illuminating engineering division of Charles H. Tenney & Company in New England properties operated by this organization have resulted in improved methods, adding an estimated annual energy consumption of 23,000 kw.-hr. to the service of these customers. At an average cost of about $110 per year per store the lighting will be much improved in quality. W. S. Wallace is in charge of this work.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Hydro-Electric Development and Steam Equipment

Pulverized-Fuel Developments.—A. J. T. TAYLOR—A discussion of the development of pulverized-fuel equipment and of the question whether the coals mined in Canada can successfully be burned in pulverized form, a description of typical installations that have proved efficient and a definition of the advantages of pulverized systems are contained in this article. A table is given showing representative purchases of pulverized-fuel equipment. This table gives the number and make of boilers, the heating surface of each boiler and total rated horsepower.—*Canadian Engineer,* Sept. 18, 1923.

Condenser Records Show Air Leaks, Tube Scale or Good Performance.—S. THOMAS.—In a previous article, "Determining Efficient Condenser Operation and Causes of Low Vacuum," which appeared in the Sept. 11 issue, the author described in detail a convenient method of calculating results and interpreting condenser records. In this issue the method is shown and applied in practice to a 16,000-sq.ft. condenser serving an 8,000-kw. turbine.—*Power,* Oct. 9, 1923.

Generation, Control, Switching and Protection

Ventilation of Central-Station Buildings and Equipment.—Data and discussion of a general nature dealing with the employment or conditioning of masses of air have been included in this report for the sake of convenient reference in connection with the presentation of present practice. The report covers forty-six pages and discusses the equipment requiring artificial ventilation, substation ventilation and its many phases, various types of coolers, duct design for mechanical draft and various methods of ventilating electrical machinery.—*Report of Sub-Committee on Ventilation of N. E. L. A. Electrical Apparatus Committee,* October, 1923.

Magneto-Mechanical Loads on Bus Supports.—L. N. ROBINSON.—Current progress in electrical development and the increasing capacity of power systems have brought into prominence many factors of mechanical strength that were previously negligible in the design of electric stations and circuits. Heavy currents that may develop during short circuits in stations that are connected to large generating systems make it essential that bus and cable supports be strong mechanically as well as adequately insulated. Formulas are given for estimating the forces that may be developed under various conditions with different arrangements of the conductors and supports. The mechanical strength of bus and cable supports should be guaranteed by manufacturers and tested, as well as the insulating qualities. In order to facilitate the selection of bus and cable supports, it is desirable that uniform terms for expressing the various kinds of loads, standard methods of conducting tests and a minimum factor of safety for mechanical strength be adopted. This paper was presented at the Pacific Coast convention of the A. I. E. E.—*Journal of A. I. E. E.,* October, 1923.

Transmission, Substations and Distribution

Oil Bushing for 200,000 Volts.—F. PATZELT.—While there is no present, and probably no future, requirement for high-voltage apparatus of more than 100 kv. in Germany, the desire to compete in foreign installations has led to the development of high-voltage bushings for an operating voltage of 200 kv. with a test voltage of 450 kv. The lack of suitable paper of the required width and of coating machinery has made it impossible to build such a bushing as a dry condenser type. A design has therefore been chosen representing a combination of condenser type and oil-filled lead. The central part of the bushing is built up as a condenser, with paper as a dielectric. It is surrounded by a four-part hollow porcelain part closed on top and bottom by a tightly fitting metallic cap. Near the middle part of the lead, where it is held on the cover of the transformer, switch or wall, a pipe connection is provided, from which a flexible metallic hose leads to an external oil conservator. The complete bushing weighs about one ton. The great cost of this bushing is largely compensated by the possibility of arranging an annular current transformer as well as two metallic rings near the ground end for voltage measurements directly on the bushing. It is thus permissible to use the bushing as a complete measuring, ground-detecting, synchronizing and relay-operating device. The lead may be used straight or under an angle of as much as 30 deg.—*Siemens Zeitschrift,* August and September, 1923.

Electric Line Calculations.—W. T. J. ATKINS.—The type of network usually found in practice—i.e., one feeding scattered loads and having a complicated lay-out—is nearly always neglected, or at best receives summary treatment, in literature dealing with the subject of line calculations. The fundamental principles are here briefly reviewed, and methods based on the principle of superposition are described which permit problems of any degree of complexity to be solved by successive approximation. The work involved in the solution is much less than that necessitated by a direct method, as the limits of accuracy of the data are generally fairly wide. The calculation of short-circuit currents and of their heating effect is also described and examples are given.—*Journal of Institution of Electrical Engineers (England),* September, 1923.

Converting Alternating Current to Direct Current by Mercury-Arc Rectifiers.—R. L. MORRISON.—The author discussed the subject under the following headings: (1) The need for a simple stationary converter that can be compared with the static transformer; (2) valve action of the mercury arc, with fundamental considerations underlying it; (3) the efficiency of this form of converter, high for high-pressure direct-current conditions, thus making it eminently suited to main-line electrification; (4) single-phase and polyphase rectifiers with wave forms; (5) special transformer enabling both halves of alternating wave to be utilized; (6) construction of large rectifiers; (7) sealing against atmosphere; (8) anode material and its effect on the continuous operation of the plant; (9) main auxiliaries, i.e., vacuum pump, ignition converter, etc.; (10) sizes at present manufactured; (11) operation in conjunction with other types of converter; (12) overloading; (13) rectifiers especially for high-tension direct-current work, with details of those at work on the Midi line of France; (14) upkeep; (15) automatic control; (16) advantages and general information.—*Paper presented before the British Association at Liverpool, England,* Sept. 12-19, 1923.

Floating Neutral n-Phase Systems.—L. A. DOGGETT.—An abstract of this paper may be found in the ELECTRICAL WORLD report of the A. I. E. E. summer convention, July 7, 1923, page 18.—*Journal of A. I. E. E.,* October, 1923.

Units, Measurements and Instruments

Additional Losses in Synchronous Machines and Their Measurement.—R. RÜDENBERG.—When calculating the efficiency of synchronous machines the additional losses due to eddies in various parts of the machine have heretofore been neglected as accurate methods of measuring their magnitude have not been known. In the first part of this paper the author calculates the stray fields of synchronous generators, located mainly at the air gap, the coil ends and their surroundings, making it possible to predetermine these losses when the machine is designed. As the usual copper losses are always considerably smaller on high-speed machines than on the slow-running types, the author maintains that the relation between the additional losses and the usual copper losses is of no great importance on low-speed machines, but

may become of such decisive prominence on all high-speed generators or motors as to influence the design and the cooling arrangement. While the subject of this article would lend itself readily to most elaborate mathematical derivations, the author confines himself to numerical calculations on actual machines.—*Bulletin de l'Association Suisse des Electriciens*, September, 1923.

Study of Insulating Materials.—Two reports of the British Electrical and Allied Industries Research Association on this subject are given. The first report gives the directions for the study of vulcanized fiber for electrical purposes. It includes the various kinds of materials that fall under this classification, definition of terms and method of making both physical and electrical tests. The second report gives the direction for the study of electrical insulating paper for purposes other than the manufacture of cables. The papers covered are not varnished or impregnated with insulating compound. This report includes definitions, processes of treatment during manufacture, tests and schedule of uses.—*Journal of Institution of Electrical Engineers* (*England*), September, 1923.

Illumination

Short-Wave Radiation from Tungsten Filaments.—M. LUCKIESH, L. L. HOLLADAY and A. H. TAYLOR.—An investigation has been conducted by the authors to determine the change of actinicity of the radiation from incandescent tungsten with temperature of the tungsten and to determine the decrease of actinicity of the radiation after traversing specimens of glass, chiefly those used in tungsten-filament lamp bulbs. The description of the apparatus and method of procedure is preceded by a short introduction giving the results of former investigations on the subject.—*Journal of Franklin Institute*, September, 1923.

Motors and Control

Installation, Operation and Care of Electric Motors and Generators.—Detailed instructions for the proper installation, operation and care of electric motors and generators are given. The life and successful operation of these machines depend upon their proper installation and maintenance as well as upon their design and manufacture. While motors and generators require less care than almost any other type of power apparatus, neglect of the fundamental requirements may lead to serious trouble, if not to the loss of the equipment. Standard definitions referring to motors and generators are also given.—*Booklet of Electric Power Club*, September, 1923.

Tooth Frequency Iron Losses in Slip-Ring Induction Motors.—D. B. HOSEASON.—In high-speed slip-ring machines, especially those having open slots in the stator, it may occasionally be observed that the iron loss is lower with the rotor open-circuited and stationary than when the rotor is short-circuited and running light near synchronism, even though in the former case the rotor iron is subjected to the impressed frequency. In such machines the tooth frequency losses are of the same order as the stator fundamental frequency losses, and the two should consequently receive equal consideration when the machine is being designed. An examination of the condition existing in a machine having either semi-closed or open slots will show that it is possible, when choosing the slots, to eliminate pulsation losses completely from either the stator or rotor, but not from both. Surface losses will always exist to some extent in all machines. — *Electrician* (*England*), Sept. 7, 1923.

Heat Applications and Material Handling

Material-Handling Problems in Pier Design.—C. R. THOMPSON.—A review of the proceedings of several material-handling symposiums held by the A. S. M. E. to discuss material handling in its relation to port development. It discusses control and operation of facilities, local conditions, bulk and miscellaneous cargoes and tracks.—*Mechanical Engineering*, September, 1923.

Electric Heating Pad.—A. SCHERBIUS.—This electric heating pad is a bimetallic thermostat with an automatic break contact embedded in the pad itself. A special heating coil, separated from the main heating unit, controls the thermostat, so that a positive and fully reliable regulation of the heating-pad temperature is obtained. This arrangement, in connection with an additional fusible link of low melting alloy, will, it is asserted, prevent the danger from fire common to existing pads. A universal pad with two heat-controlled thermostats and two fuses is also described. This can be connected without any adjustments to either 110-volt or 220-volt systems, reaching with either voltage the same final temperature. The pad last mentioned is of particular advantage to the traveling public.—*Elektrotechnische Zeitschrift*, Sept. 13, 1923.

Electrophysics, Electrochemistry and Batteries

Recent Progress in the Production of Ozone with High-Tension Discharges.—F. E. HARTMAN.—The author deals with the production of ozone by the so-called silent discharge. Data are given which show that the energy density of an ozonizer is a straight-line function of the cycles and that the yield of ozone is a straight-line function of the energy density at atmospheric pressure. It is further shown that ozonizing at high gas pressures is conducive to better cooling of the electrodes, thus making it possible to produce high concentrations of ozone with high energy densities. A relationship is also established between high gas pressures and the efficiency of an ozonizer.—*Paper presented before the American Electrochemical Society at Dayton, Ohio*, Sept. 27-29, 1923.

Traction

Turbo-Electric Condensing Locomotive.—An experimental locomotive of the above type has been under development in England for the past two years and has been submitted to numerous stationary and road tests. The locomotive is 69 ft. 7½ in. long over all, weighs 293,000 lb. in working order and has a rated traction force of 22,000 lb. It consists of two sections connected together by a universal joint, each section carried on three pairs of driving wheels and a two-wheel truck. The front section contains the boiler, under which is placed the main turbine and generator and the auxiliary turbine and generator, while the back section contains the condenser with fan, water tanks and coal bunker. The main turbine is of the impulse type and contains nine stages, the mean blade diameter being 36 in. It is designed for a steam pressure of 200 lb. per square inch superheated 300 deg. F. and exhausting to a vacuum 27½ in. The turbine drives a three-phase generator rated at 890 kw. at 3,600 r.p.m. and 600 volts.—*Railway Age*, Oct. 13, 1923.

Suburban Electrification at Melbourne, Australia.—Important improvements in train service and operating expenses have resulted from the electrification of the extensive suburban system of the Victoria Government Railways at Melbourne, Australia. Notable features in this new installation are the operation of suburban electric and main-line steam traffic on the same lines, the high speed and better service at lower cost (resulting in increase in traffic and revenue) and the adoption of through routing instead of having all trains terminate at the city. All trains have American motor, electrical and brake equipment.—*Engineering News-Record*, Oct. 11, 1923.

Telegraphy, Telephony, Radio and Signals

Wireless Direction Finding in Steel Ships.—C. E. HORTON.—The problems of direction finding which are peculiar to ships are discussed. A method of observing the action of a ship on wireless waves is given, as well as means of correction for the deviations so produced. The precautions to be taken in the calibration of a ship direction finder are indicated. A laboratory method of investigating the action of metal structures is described, and the use of multiple-aerial systems is considered. — *Journal of Institution of Electrical Engineers* (*England*), September, 1923.

Three-Electrode Tubes Used for the Production of Continuous Waves in Radio Telegraphy. — M. LATOUR and H. CHIREIX.—The theoretical limiting efficiencies of vacuum-tube oscillators for various wave forms of plate current are mathematically investigated and discussed.—*Proceedings of the Institute of Radio Engineers*, October, 1923.

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Supreme Court to Rehear West Virginia Gas Case

On the petition of the Attorney-General for West Virginia, the United States Supreme Court has taken a step very unusual with it in ordering a rehearing on Nov. 19 in the case in which the court by a six to three decision last June (see ELECTRICAL WORLD, June 16, page 1429) held that West Virginia could not refuse to supply industries and municipalities in Pennsylvania and Ohio with natural gas. The June decision said, in effect, that natural gas is a lawful article of commerce, that its transmission from one state to another for sale and consumption is interstate commerce, and that therefore West Virginia cannot refuse to sell natural gas to Ohio and Pennsylvania consumers.

From this decision Justices Holmes, Brandeis and McReynolds dissented. The bearing of the case on interstate transmission of electrical energy is obvious.

Drought in the South Hits Hydro-Electric Plants

Drought continues in the Southeastern States. The curtailment program of the Southern Power Company, which became effective on Oct. 22, was still in effect at last reports, with no immediate prospect of its abandonment. There has been some rainfall, but not enough to have any appreciable effect on the situation. The Piedmont Power & Light Company of Burlington, N. C., has bridged the situation for industrial users of Southern Power Company power in that city by furnishing power from its steam plant on the day curtailment is effective there.

The drought has also played havoc with the production of hydro-electric power at the plants of the Tennessee Electric Power Company, and as a consequence the company is operating its three steam plants at Parksville, Nashville and Knoxville at almost full capacity. These plants are producing 43,000 kw. The water plant at Hales Bar is down to 12,000 kw.

The Tennessee Electric Power Company is now indirectly furnishing power to the Carolinas, and in addition to this about 100,000 kw. is being furnished nightly to the Georgia Railway & Power Company.

Officials of the last-named company say that it is not likely any curtailment of industry will result in Georgia, the company being well equipped to supplement the hydro-electric power with steam power from its own plants and by means of interconnection. The rainfall in the district this year has been about 10 in. less than last year at this time, and in addition to this industries have been operating on a much more extensive basis, with the result that there has also been a considerably greater demand for electric power.

No Move on Diamond Creek

Federal Commission Again Postpones Action, Leaving Girand Project in Statu Quo

NO LICENSE will be issued to James B. Girand at this time by the Federal Power Commission, but the priorities attaching to this application for a license covering the large development at Diamond Creek on the Colorado River will remain in force.

In agreeing to postpone action on the license, it is believed that Secretary Weeks, who held the deciding vote, was influenced by the assurances of Senator Ashurst of Arizona that the Colorado River compact would be ratified by Arizona when the Legislature meets in special session in January. Secretary Wallace was in favor of granting the license immediately. Secretary Work was for indefinite postponement. Before taking final action it is understood the matter was laid before the President. Mr. Coolidge, it was said, was not disposed to intervene in the matter. The decision of the commission not to grant the license at this time does not mean, it is believed, that it may not take action should it become apparent that Arizona will refuse to renew Mr. Girand's state permit, which expires Dec. 26.

Owing to the fact that much weight has been given the opinion of R. E. Caldwell, the State Engineer of Utah, to the effect that Arizona will not ratify the compact if the Girand license is granted, Mr. Girand insists that Mr. Caldwell's opinion should be considered as an interested one. He points out that Mr. Caldwell is the engineer for the New York interests that are financing the Paradise Verde project north of Phoenix. While that venture is classed as an irrigation project, it includes the development of 90,000 hp. of hydro-electric energy. The logical market for that power is at the Arizona copper mines. Evidently no reflection on Mr. Caldwell is intended, but Mr. Girand feels that Mr. Caldwell's interest in securing a market for the power to be developed on the Verde would tend to warp his judgment.

High-Tension Line to Be Built from Keokuk to Galesburg

A double-circuit, steel-tower transmission line, carrying 66,000 volts, will be built from the big power dam at Keokuk, Iowa, to Galesburg, Ill., by the Illinois Power & Light Corporation, officials of the company announced this week. An extension of the line, carrying 33,000 volts, will also be built from Galesburg to Galva, a distance of 23 miles, making the entire length of the new line development 96 miles.

The new line will start at the dam owned by the Mississippi River Power Company at Keokuk. It will run up the Iowa side of the Mississippi River to Fort Madison, cross the river at this point and then extend in a northeasterly direction to Galesburg, following generally the main line of the Santa Fé Railway. The Galesburg power plant of the company is now up to its full rating of 4,500 kw. The new line will be capable of increasing its capacity to 10,000 kw., sufficient, it is believed, for the next ten years. The Galesburg and Galva power houses will be kept intact and used as standby plants. The improvement will cost $1,250,000.

Feather River Project's Ultimate Capacity 202,000 Hp.

The development program for northern California laid down by the recently organized Feather River Power Company includes six power plants and five large reservoirs on the Middle Fork of the Feather River and its tributaries and eventually will develop 202,000 hp. minimum output of electrical energy and provide irrigation for between 75,000 and 100,000 acres of land as a by-product of the power feature. To accomplish this will necessitate the building of about seven constant-angle arch dams and two multiple-arch dams. Lars R. Jorgensen holds the permit from the Federal Power Commission for the first power house and the reservoirs for the initial development. Two of the reservoirs probably will be completed during 1924, and construction on the first power house is to begin early in 1925.

The first power plant will generate 62,000 hp. from 942 ft. of effective head, 3½ mi. of tunnel, a diversion dam and about an eighth of a mile of pressure pipe from the forebay to the power house. This will be known as the Bean Creek power plant and will be built about 18 miles above Oroville.

Investment Bankers Meet

Need of Uniform State Regulation of Utilities in Security Holders' Interest Emphasized

THE need of uniform laws for the state regulation of public utilities was dwelt upon in the report of the committee on public service securities made at the Investment Bankers' Association convention at Washington on Tuesday, Oct. 30, by Henry R. Hayes of Stone & Webster, and it was recommended that the association urge, wherever lacking, that the state commissions be vested with authority over the valuation, rates, services and capitalization of privately owned plants and that there be published full financial reports of operation.

Pointing out that investors are disposed to withhold funds from business affected by "purely political" agitations, the committee said that such a situation "cramps a utility and the public is eventually not adequately served." "It has become more evident," the report added, "that a development of local sales of investment securities by operating companies direct to users of service will be helpful in preventing such unfair political attacks."

"When administered with the broadest powers and in a judicial manner, state-wide regulation of public utilities has been conclusively proved," the committee maintained, "to afford the best guarantees which investors can have in this country for a maintenance of that integrity of investment necessary for a ready flow of money into the business."

The report outlined the expansion of the public utility business in the last year and pointed to the sale within the last two and one-half years of nearly $2,500,000,000 in bonds, notes and stocks. This expansion, it said, was continuing. The task of raising funds for public utilities, the committee found, "has been made difficult because of the general systems of taxation throughout the country."

"Happily," the report continued, "in the interests of the industry and the public served, there is evident to a marked degree a steady broadening of the market for utility securities. It is noticeable in two ways—first, in an increased demand from institutions such as savings banks and insurance companies which gather in the small savings of the people; and, second, in the last three years especially, by sales of securities to the extent of many hundred millions of dollars direct by companies to the users of utility service."

The report drew attention to the rapid growth of the electrical industry, dwelling on its tendency to leap state boundaries by means of interconnected and superpower systems.

Secretary of Commerce Hoover spoke at the banquet on Wednesday evening, urging the investment bankers to find the money for forwarding electrical interconnection. The function of the investment banker, he said, is to find money for the advancing equipment of the nation. It is the duty of the engineer to bring the case before the investment banker.

Osgood and Skinner A. I. E. E. Presidential Nominees

C. E. SKINNER and FARLEY OSGOOD have both been placed in nomination by petition for president of the American Institute of Electrical Engineers for the presidential year 1924-25. Both Mr. Skinner and Mr. Osgood are well known in Institute circles and both have a record of accomplishment and service to the Institute to their credit.

FARLEY OSGOOD

C. E. SKINNER

C. E. SKINNER is best known as the director of research of the Westinghouse Electric & Manufacturing Company, which position he held for a great number of years. He recently became assistant director of engineering, devoting most of his time to the work of standardization both in America and internationally.

Mr. Skinner is a native of Ohio, born in 1865, and is a graduate of the Ohio State University. He has been with the Westinghouse organization ever since graduation, and his record there is one of continuous accomplishment. It was he who organized the research division in 1906. Mr. Skinner is a fellow of the American Institute of Electrical Engineers and has represented the A. I. E. E. on the International Electrotechnical Commission, having been chairman of the American delegates to the Brussels meeting in 1920. He also has represented the Institute on the American Engineering Standards Committee, the Engineering Council and the American Engineering Council. He is a member of the Franklin Institute, the American Technical Society and the American Society for Testing Materials. He was a member of the National Research Council in 1917 and 1918. In Institute activities he has served on the following committees: Edison medal, editing, education, electrophysics, executive, public policy, research, safety codes, standards. He was a manager of the Institute in 1915-1919 and vice-president in 1919-1920.

FARLEY OSGOOD is best known as an operating man, he having been for the last six years vice-president and general manager of the Public Service Electric Company of New Jersey. Mr. Osgood was born in Boston in 1874 and was graduated from the Massachusetts Institute of Technology in 1897. He spent five years with the American Telephone & Telegraph Company and then became chief engineer and general manager of the New Milford Power Company in Connecticut, four years later becoming general superintendent of distribution for the Public Service Electric Company. His advance in that organization was rapid.

Mr. Osgood is a fellow of the A. I. E. E. and has always been active in association work. He was a representative of the A. I. E. E. in the formulation of the National Electrical Code. He has served as chairman of the New York Section and also was manager of the Institute in 1911 to 1914 and vice-president from 1914 to 1916. In addition, he has served on the following committees: Standards, Edison medal, overhead and underground line construction, executive, finance, joint power - factor and safety codes (chairman). He has also been active in N. E. L. A. committee work.

According to the Institute procedure, the membership at large will vote on nominations next spring.

Death of Charles P. Steinmetz

Career of Internationally Famous Engineer Is Suddenly Ended at His Schenectady Home—His Writings and Inventions —Romantic Incidents of His Life

ANNOUNCEMENT of the sudden death from heart trouble at Schenectady, N. Y., on Friday morning, Oct. 26, of Charles Proteus Steinmetz came as a shock not only to the men of the electrical industry but to the adoptive nation of which he had become an outstanding citizen. He had a week or two before returned, somewhat exhausted, from a trip to the West, where he had been greeted with enthusiasm in half a dozen cities and had participated in the Pacific Coast convention of the American Institute of Electrical Engineers.

To the great public, familiar through scores of newspaper articles with the romantic incidents in his life, Dr. Steinmetz was the "electrical wizard," the crippled and penniless German immigrant, passing with difficulty the United States inspectors, who rose to be a sort of diminutive Jove, enthroned in an Olympian laboratory, launching thunderbolts at will, emitting widespread prophecies of future electrical elysiums, in supposed receipt of a fabulous salary, and yet clinging doggedly to the Marxian social philosophy to which a too practical devotion had driven him from his native land, and ready at any time to break a lance for socialism or run for office on its ticket.

To technicians and engineers, on the other hand, he was the mathematical expert, the accomplished chemist, the brilliant electrophysicist whose reputation had spread wherever science has its votaries, and yet withal the practical electrical engineer with about two hundred patents and many indispensable treatises to his credit. His inventions are not, to the lay mind, sensational, like Edison's. His books are not for the multitude. He had the gift of popular exposition—as was evidenced only a year ago when he published his last work, four lectures on the Einstein theory, portions of which contained possibly the clearest explanation of that hypothesis and of non-Euclidean geometry ever presented to lay readers, though the author soon began joyfully to thread a mathematical labyrinth where only the learned could follow—but he wrote in the main for technical scholars.

His Technical Career

To the "human interest" of his career, with the emphasis put on episodes and incidents perhaps slightly apocryphal, the daily newspapers all over the land have done full justice. The story of his long connection with and splendid accomplishments for the electrical industry remains to be told. It can here be recounted only in brief.

Charles P. Steinmetz was born on April 9, 1865, in Breslau, Germany. His father was not without means, and young Steinmetz received a thorough scientific training in his native city, in Berlin and in Zurich, Switzerland. Electrical science was then in its infancy, but Steinmetz mastered what of it there was, studying besides mathematics, chemistry, physics, mechanical engineering, astronomy and even medicine.

Charles P. Steinmetz

When he emigrated to America in 1889 he was, perhaps as one result of his socialistic activities, dependent entirely on his own exertions, though he bore with him a letter of introduction from the editor of the *Elektrotechnische Zeitung*. He soon found employment with the Osterheld & Eichemeyer Manufacturing Company of Yonkers, N. Y., first as draftsman, then as electrical engineer and designer, and finally on research work in charge of the Eichemeyer laboratory.

With the absorption of the Eichemeyer interests by the General Electric Company, Steinmetz joined the latter and was attached to the calculating department in Lynn, Mass. On the transfer of General Electric headquarters to Schenectady in the spring of 1894 he organized and took charge of the calculation and design of the company's apparatus and also interested himself in its research and development work. For virtually all of the thirty years of his connection with the General Electric Company he was its chief consulting engineer, for much of that time in charge of vast and intricate work.

His Hysteresis Research

How rapidly Dr. Steinmetz was able, concurrently with the acquisition of the English tongue, to master the new art and science and to keep pace with its phenomenal growth is shown by the fact that in 1890, a year after his arrival in America, he was making hysteresis tests and designing a single-phase commutating motor. In December of that year he published "Notes on the Law of Hysteresis" in the *Electrical Engineer*. In January, 1892, and again in September, he read papers on hysteresis before the American Institute of Electrical Engineers and was seen to be a coming man.

Early in his career Dr. Steinmetz was appointed professor of electrical engineering at Union College, in Schenectady, a post which did not involve the severing of his relations with the General Electric Company. Later his title was changed to professor of electrophysics, and this chair he held up to the day of his death.

As a writer and an instructor he was equally at home in pure and in applied science, and no one did more than he to bridge the gap between them. Harvard granted him an honorary A.M. in 1902, and Union an honorary Ph.D. in 1903. Other honors that fell to his lot were the presidency of the A. I. E. E. in 1901-2 and the presidency of the Illuminating Engineering Society in 1915-16. He was a member of many other engineering and technical societies and always ready to do his share in their work.

His inventions were concerned largely with the transmission of power and the design of alternating-current machinery, although they also covered the magnetite-arc and other electric lamps, as well as elevator motor appliances and electrically propelled vehicles. Smoke elimination processes and similar matters of this practical sort shared his attention with research into transient phenomena, development of the symbolic method of alternating-current calculations and other abstruse occupations. While out in the open air he is said to have solved difficult problems by mental computation without pencil and paper.

Dr. Steinmetz was the author of the following books, all classics in their field and recognized college texts: "Theory and Calculation of Alternating-Current Phenomena," 1897; "Theoretical Elements of Electrical Engineering," 1901; "General Lectures on Electrical Engineering," 1908; "Theory and Calculation of Transient Electric Phenomena and Oscillations," 1909; "Radiation, Light and Illumination," 1909; "Electrical Engineering Mathematics," 1910; "Electric Discharges, Waves and Impulses," 1911; "Theory and Calculation of Electric Circuits," 1917; "Theory and Calculation of Electrical Apparatus," 1917. The dates given are those of the first editions. He was, in addition, the author of whole series of papers and records of investigations and of many articles for the technical press, some of which first appeared in the ELECTRICAL WORLD.

Proof of Dr. Steinmetz' versatility is found in his additional authorship of a work in German on "Astronomy and Meteorology" (1889), of "America and the New Epoch" (1916) and of the lectures on the Einstein theory already mentioned. He was in demand as a popular lecturer on varied topics. He became president of the Schenectady Board of Education in 1912 and of the Schenectady Common Council in 1916. He took delight in nature study and the culture of plants and was an ardent canoeist.

FUNERAL CEREMONIES

Many hundred persons viewed Dr. Steinmetz' body as it lay in state at his home or gathered at the cemetery on Monday afternoon, when it was interred. The services themselves, in accordance with his character, were of the simplest description. They were held under Unitarian auspices and attended only by relatives by blood or adoption and a few intimate friends. The honorary pallbearers were Chairman Owen D. Young, President Gerard Swope and Honorary Chairman E. W. Rice, Jr., of the General Electric Company, President Charles A. Richmond of Union College, Dr. Ernst J. Berg and Lieut.-Gov. George R. Lunn. Five minutes of silence was observed at all the plants of the General Electric Company in Schenectady and elsewhere.

Tributes to the Man and the Engineer

Leading Members of the Electric Fraternity Estimate the Achievements of Dr. Steinmetz and Express the Sense of Loss His Associates Feel

IT WOULD be impossible to print more than a few of the tributes to Dr. Steinmetz as a man, a scientist and an engineer that his death has called forth. Those that follow, prepared for the ELECTRICAL WORLD, will be of especial interest to its readers.

From **Herbert Hoover,**
Secretary of Commerce:

"The death of Steinmetz marks the passing of an outstanding figure in the world of electricity. He combined the imagination of genius with an uncanny ability to visualize practical applications resultant therefrom. His mathematical reasoning broke the path for many of the advances in electrical engineering in recent years and solved problems that were vital to the progress of the industry. In his writings he has left engineers a heritage of mathematics that will endure, and as a man he has set us all an example of physical courage and of devotion to our life work."

From **E. W. Rice, Jr.,**
Honorary Chairman of the Board, General Electric Company:

"Steinmetz was a prolific inventor, a skilled mathematician, a trained engineer and an inspiring teacher. Our generation has produced men who have equaled or excelled him in some one of his fields, but no one has arisen who to such a superlative degree combined the qualities of an inventor, mathematician, engineer and teacher. His most important scientific and mathematical contributions to the electrical industry may be regarded as the investigation of magnetism, especially the determination of the law of hysteresis, the development of a symbolic method of alternating-current calculations and researches in the general field of electrical transients. Of his inventions, which are set forth in some two hundred patents, perhaps the most important are the induction regulator, a method of phase transformation (as from two-phase to three-phase) and the magnetite-arc lamp. He possessed a marvelous insight into scientific phenomena and had unequaled ability to explain in simple language the most difficult and abstruse problems. He was patient, sympathetic, cheerful and ever willing to share his great gifts with all those who sought his advice."

From **Elihu Thomson,**
Consulting Engineer, General Electric Company, Lynn, Mass.:

"Dr. Steinmetz came into our organization thirty-five years ago, and from the start showed very high and exceptional ability in applying mathematical principles to electrical problems, such that he became the recognized leader in that field all over the world. His unflagging industry is seen in the many papers and books from his pen embodying his original studies in this field. His loss will be severely felt in the scientific and engineering circles of the electrical world. We who have known him intimately and were in a position to recognize his great and exceptional ability as an investigator and teacher will best understand the vacancy in the ranks which has been created by his unexpected death."

From **Prof. Harris J. Ryan,**
President American Institute of Electrical Engineers:

"Through life from early youth Dr. Steinmetz was a profound student of the sciences, industries, linguistic arts and humanities. He worked constantly for their co-ordinated understanding in preparation for the solution of problems defined for progress. Through a decade he led the advance of electrical engineers to the modern understanding of the electric circuit, the transformer, induction motor, alternator and high-voltage phenomena. Dr. Steinmetz assisted his brother engineers to an untold degree by his books, papers and discussions, by his profoundly intelligent vision and by his example of persistent, ably directed enthusiasm."

From **A. E. Kennelly,**
Professor of Electrical Engineering, Harvard University:

"Dr. Steinmetz was one man in many millions in his unique personality and extraordinary comprehension of both theoretical and applied electricity. He was a great genius, thinking and acting in his own peculiar way, blessed with a keen sense of humor and of many-sided interests. The best of Steinmetz appears in his professional papers and discussions rather than in his books. The breadth of his understanding resembled that of Lord Kelvin. Contrary to a widespread impression, Steinmetz' great mathematical powers were subordinated in his writings to the use of comparatively simple mathematics. It was a hopeful circumstance that his keen mind had been led to study the pressing problems of high-voltage cable design and operation with due comprehension of their importance to the central-station industry, and the loss of this rare being leaves a gap which cannot be filled in the ranks of great men."

From **Charles F. Scott,**
Professor of Electrical Engineering, Yale University:

"Steinmetz was an extraordinary man from every viewpoint. He had a profound influence in the national organization of his profession. His presidency of the American Institute of Electrical Engineers a score of years ago inspired new life and interest; it was the beginning of a rapid growth in membership and in activity. Not only his administration of its affairs, but the many notable and fundamental technical papers he contributed, the marvelously lucid and clarifying summary which he often gave to audiences confused by abstruse papers and discussions, his discriminating counsel in the early years of the standards committee—all this and more make him the outstanding member in the life of the Institute."

From **S. W. Stratton,**
President Massachusetts Institute of Technology:

"Dr. Steinmetz was perhaps the ablest man in America in theoretical electricity. His great mathematical talents were combined with an insight into engineering that enabled him always to keep his feet upon the ground. He contributed richly to research, espe-

cially in the field of high-voltage phenomena."

From **R. A. Millikan,**
Director of Physics, California Institute of Technology:

"The passing of Dr. Steinmetz is a great loss to the electrical industry of the world. He was one of the few electrical engineers who understood the importance of the application of modern mathematics and physics to engineering problems. He has performed a great service in impressing these values, through his books and his lectures, upon the younger generation of American electrical engineers. In addition, Dr. Steinmetz was extraordinary in his breadth of human sympathy, his devotion to ideals and in his continual effort to improve human society. America and the world lose irreparably by his death."

From **Dugald C. Jackson,**
Consulting Engineer, Boston:

"One of the most trenchant and fascinating minds in electrical engineering was that of Dr. Steinmetz. He showed great originality in methods of attack upon problems, accompanied by remarkable clarity and effectiveness in the presentation of points. He had very unusual keenness of judgment upon the engineering value of inventions. Many patents were taken out by him, but his work as a whole dealt with the broader problems of electrical engineering. Our profession owes the fundamental analysis of machine design by vectorial methods to Steinmetz's Institute paper of 1892, and to his championship of three-phase distribution the electrical industry is greatly indebted. His was a master philosopher's mind in electrical science."

From **B. A. Behrend,**
Consulting Engineer, Brookline, Mass.:

"Dr. Steinmetz had a great methodical mind, without, however, a versatile imagination. He was less of an originator than a teacher. His great encyclopedic textbooks show the consistent systematic application of one method to the phenomena of electricity. He became the foremost instructor and guide to the great class of official teachers at our colleges, and justly will this achievement be remembered as one of his greatest next to the ever-stimulating influence of his personality."

From **F. B. Jewett,**
Vice-President Western Electric Company and Past-President A.I.E.E.:

"Dr. Steinmetz exhibited an untiring and almost incredible energy in making concretely effective the workings of his fertile brain and his vivid imagination. Throughout practically his entire life in America he was looked upon as one of the outstanding leaders in the field of electrical research. Because of the fact that his scientific interests were so varied and catholic it is difficult for his contemporaries to appraise justly Dr. Steinmetz's works. It seems clear, however, that among his many contributions to electrical engineering his work in adapting simplified mathematical tools to the needs of a new and complex art alone is sufficient to entitle him to a place in the front rank. He did much to raise the Institute to its present high place as one of the great professional engineering societies of the world. His work in this connection was never primarily that of an organizer of other people's activities. It was always that of a true scientist and engineer who by performance and precept worked ever to raise the standard of technical excellence in his chosen profession."

From **B. G. Lamme,**
Chief Engineer Westinghouse Electric & Manufacturing Company:

"I deeply regret the loss of Dr. Steinmetz as a personal friend and because his death means the passing of a brilliant and analytical engineer. He was a very able man who contributed much to the electrical industry. He was a witty, sociable man, quite human in his dealings with his fellow men. The public, to which he was known as a man of mystery, would have found as I did in personal contact a real human being. He and I entered the electrical business within a month of each other in 1889, at the start of what engineers call the analytical period, when mathematical analysis took the place of cut-and-try experiment. His greatest fame was achieved during this period of rapid electrical expansion, during which he contributed greatly to scientific analysis of electrical phenomena. Unlike many brilliant engineers, he left a record of his work in his numerous writings, so that his contributions to science will live in engineering journals. His keen mind was nowhere more clearly displayed than in these contributions."

From **Martin M. Foss,**
Vice-President McGraw-Hill Book Company:

"To those who have known the range of Dr. Steinmetz' activities and accomplishment it is a twofold marvel that he was willing to devote so much time to the production of new books and that he faithfully and constantly revised the older works so that they might stand always, as they do today, ahead of present-day practice and in the van of theoretical research. Dr. Steinmetz clearly regarded his books in the same light as his technical researches. They were part of his professional activity. Their wide use as textbooks in this country and abroad, and especially the quantities used by Japanese universities, interested him greatly. Many of them have been translated into both French and German and so made available to engineers throughout the world."

Among personal tributes paid to Dr. Steinmetz at a meeting held under Socialist auspices in New York last Sunday was one from a close associate, a consulting engineer in the General Electric Company, D. B. Rushmore. Mr. Rushmore, in recalling incidents in the life of Dr. Steinmetz, said the dead inventor believed in a future life, was a very devout man, one of Schenectady's best citizens, a lover of children and had paid for the education of large numbers of young men and women.

Steinmetz as a Mathematician

By Vladimir Karapetoff
Professor of Electrical Engineering, Cornell

Dr. Steinmetz' mathematical mind corresponded more closely to the biblical man with one talent rather than to him with ten talents, in the sense that Steinmetz used comparatively elementary mathematics only, hardly ever beyond ordinary calculus and linear differential equations. But within these means he had complete mastery of the subject and endeavored to give exact or approximate quantitative relations in every problem that came within the range of his attention. In other words, whatever he knew of mathematics he used unstintedly and with remarkable skill for the benefit of the profession.

His mathematical fame rests rightly on the boldness and acumen with which he always picked out the salient features of a seemingly complicated phenomenon and wrote mathematical formulas expressing it. Nor did he ever lose sight of the physical nature of the phenomenon or of the relative order of magnitude of the quantities entering into it. Therefore, his results were usually correct, and, moreover, in his writings he almost always supplemented the general deductions by carefully selected numerical examples and curves, as a double assurance that his theory did work.

Because of his consulting connection with a large manufacturing organization he was often called upon to give an opinion or an estimate on rather complicated and untried propositions. He, therefore, developed a remarkable ability of quickly estimating the order of magnitude of "uncalculable" phenomena. It was an inspiration to hear him compute (even without a pencil) the probable voltage or frequency of a lightning stroke, the energy involved in a complicated short circuit, and so on.

Steinmetz's "Alternating Current Phenomena" was a pioneer book in which he gave the now universally used mathematical methods for use in computations relating to alternating-current circuits. Moreover, he used a terminology, such as "impedance," "susceptance," "admittance," etc., that has proved to be generally acceptable. Later he generalized these methods in several brilliant A.I.E.E. papers which resulted in his best work, "Transient Electric Phenomena and Oscillations," a monumental original treatise which will retain its value for many years to come.

Americans as a nation are not a mathematically inclined people, and, owing to poor teaching of mathematics in secondary schools, American engineers have been and still are timid and averse to the use of formulas. So much more credit is due to Steinmetz for keeping on the mathematical path, in spite of a comparatively narrow early circle of readers of his Institute papers, until by his persistence he has almost forced the younger generation of engineers to think in terms of his mathematics and of his terminology.

Protest Made Against Project on New River

Railroads and seven public utilities operating in the territory contiguous to the Virginia-West Virginia border have joined in a protest to the Federal Power Commission against issuance of a license to the West Virginia Power Company for its project on the New River, 5 miles from Hinton.

The commission has granted a preliminary permit with the statement that final action will depend upon a careful survey of the development to determine the effect upon topography of adjacent land. Plans filed by the power company include construction of a dam 140 ft. high which would form a lake extending several miles from Virginia. The Norfolk & Western, Chesapeake & Ohio and Virginian Railroads have asserted that this lake would overflow and irreparably damage their rights-of-way, and power companies already in existence assert that their sites would be submerged.

Electric Light Speeds up Plant Growth

In a six weeks' test just completed by the Westinghouse Lamp Company in co-operation with Peter Henderson & Company, seedsmen, at the Henderson proving grounds at Baldwin, Long Island, N. Y., the value of electric light for accelerating the growth of a variety of plants is reported to have been conclusively proved. Many of the specimens subjected to electric light grew during the test upward of twice the size of similar plants receiving daylight only and were considered by experts to be from fourteen to twenty-seven days in advance of normal growth. Of the plants selected for testing, flowers and vegetables having large leaf surfaces, such as lettuce and endive, responded most readily to the stimulating effect of the light. The tests indicate that electric light will be useful to florists and gardeners in forcing flowers for definite dates, such as Christmas and Easter.

Preliminary tests on forcing plants by the use of artificial light were conducted by the Westinghouse Lamp Company at Columbia University, under the auspices of Prof. Hugh Findlay of the department of agriculture of the university. The results on such plants as Boston fern, calla lillies, rose geraniums and others which are much in demand by florists were extremely favorable. In almost every case the plants grew taller, continued in bloom longer and were sturdier than those that did not receive the benefit of the artificial light.

Two Westinghouse 110-volt, 2-hp. farm-lighting plants were used in the Baldwin experiments to generate power, in order to bring these tests within the reach of communities where central-station power is not available as well as those where energy can be purchased.

October Utility Financing Active

ELECTRIC light and power public utility financing during the month of October reached a total of $64,414,500, a figure which more than doubles September's total and brings the total for the ten-month period to $570,203,900 as compared with $521,584,990 for the same ten-month period of 1922. The recovery from the summer slump was not unexpected in financial circles, where a reaction had been looked for even earlier in the fall. The rate of return yielded the investor advanced to 6.25 from 6.16 in September, and the largest single item was the $11,500,000 issue of the Southern California Edison Company offered at 98½ and yielding 6.12. Long-term issues continued to predominate, but a few short-term issues also appeared during the month.

SECURITY ISSUES OF ELECTRIC SERVICE COMPANIES IN OCTOBER

Name of Company	Amount of Issue	Period, Years	Class	Purpose	Interest Rate	Price	Per Cent Yield
Queens Borough Gas & Electric Co. (N. Y.)	$2,000,000	30	Refunding mortgage gold bonds, series 1953	Additions	6	99½	6.05
Public Service Co. of Colorado	5,000,000	30	First mortgage and refunding gold bonds, series A	Construction and other corporate purposes	6	93	6.55
	2,250,000	10	Sinking-fund convertible gold debentures	Construction	7	98½	7.25
Northern Ohio Traction & Light Co.	380,000	24	General and refunding mortgage gold bonds, series A	To reimburse for property expenditures	6	93	6.59
Continental Gas & Electric Corp. (Neb.)	1,000,000	25	Refunding mortgage bonds, series A	Additions	6	93½	6.63
Standard Gas & Electric Co. (Ill.)	2,500,000	2	Gold notes	To provide increased working capital	7	100	7
Toledo Edison Company (O.)	900,000	24	First mortgage gold bonds	To reimburse for property expenditures	5	90	5.78
Kentucky Utilities Co.	2,265,000	25	First mortgage lien gold bonds, series D	Construction and other corporate purposes	6½	98½	6.63
Pennsylvania Power & Light Co.	4,000,000	30	First and refunding mortgage bonds, series C	Construction and to reimburse for capital expenditures	6	99	6.07
Metropolitan Edison Co. (Pa.)	500,000	29	First and refunding mortgage gold bonds, series B	To reimburse for capital expenditures	6	98	6.15
Ottawa Light, Heat & Power Co., Ltd. (Ont.)	500,000	30	Refunding mortgage and collateral trust bonds		6	100	6
Western United Gas & Electric Co. (Ill.)	510,000	5	Collateral trust notes	To reimburse for additions	6	97.89	6.50
American Public Service Co. (Ill.)	$1,500,000	19	First lien gold bonds	To reimburse for extensions and expenditures	6½	96.80	6.80
Italian Power Co.	2,000,000	5	Collateral trust gold bonds, series A	Refunding and additions	6½	99	6.75
Consolidated Power & Light Co. (W. Va.)	1,039,500	20	First mortgage and refunding lien sinking fund gold bonds, series A	Refunding	6½	99½	6.50
Alabama Power Co.	6,000,000	28	First mortgage lien and refunding gold bonds	Additions	6	99	6.07
Southern Oklahoma Power Co.	160,000	19	First and refunding mortgage gold bonds, series B	Additions	6	92	6.75
Wolverine Power Co. (Mich.)	1,570,000	20	First mortgage sinking-fund gold bonds	Construction	7	100	7
Portland Railway, Light & Power Co. (Ore.)	2,000,000	24	First lien and refunding mortgage gold bonds, series B	Construction	6	92½	6.63
Houston Lighting & Power Co. (Tex.)	2,000,000	30	First lien and refunding mortgage gold bonds, series B	Extensions and other corporate purposes	6	98½	6.10
Southern California Edison Co.	11,500,000	20	Refunding mortgage gold bonds	Refunding	6	98½	6.12
Philadelphia Electric Co.	10,000,000	30	First lien and refunding mortgage gold bonds	Additions and extensions	5½	98½	5.60
Iowa Railway & Light Co.	1,000,000	9	First and refunding (now first) mortgage gold bonds of 1912	Additions	5	93	6
North Missouri Power Co.	300,000	3	First and refunding mortgage collateral convertible gold notes		7	100	7
Quebec Power Co.	3,540,000	30	First mortgage sinking-fund gold bonds, series A	Refunding and additions	6	95	6.38
Total	$64,414,500						

Power Board Activities

Numerous Licenses and Permits Granted—Plan to Facilitate Handling of Minor Projects

AT THE Oct. 22 meeting of the Federal Power Board a license was authorized for Hutton, McNear & Dougherty of New York City and San Francisco covering a 29,000-hp. project on Cascade Creek, 22 miles from Petersburg, Alaska. The power is to be used in the manufacture of pulp and paper. The license is conditioned upon a contract with the Forest Service for the purchase of timber.

Licenses covering minor projects were authorized as follows: Roy Carson, Mono Lake, Cal., covering a project at Silver Lake on the South Fork of Rush Creek in the Mono National Forest; Mount Reubens Mining Company of Grant's Pass, Ore., project on Reubens Creek in the Siskiyou National Forest; Southern California Edison Company, transmission line crossing a portion of the Angeles National Forest; Idaho Power Company, transmission line between Shoshone and Richfield, Idaho; Southern Sierras Power Company, transmission line in the Cleveland National Forest; Winino Mineral Springs Company, development on Salt Creek in the Cascade National Forest, Oregon.

To facilitate the handling of minor projects, the commission authorized the executive secretary to issue licenses for ten years covering projects with a capacity of less than 100 hp. Field officers of the three departments were authorized to issue licenses for ten-year periods covering projects of 40 hp. or less. If there is a possibility of the small projects conflicting in any way with a larger project, the license is to be limited to five years.

The license previously granted to the Freshwater Bay Lumber Company of Seattle was rescinded. The company had not complied with the condition to start work before May 31, 1923, on its project on Chichagof Island, Alaska. The application of the Utah Power & Light Company for a license covering its Mink Unit on Bear River was also rescinded, at the request of the company. Investigation had shown poor foundation conditions at the site. A new application will be submitted when it is known to what extent the plans must be changed.

PRELIMINARY PERMITS

Preliminary permits were authorized for Mary Ives Crocker and J. W. Preston of San Francisco, covering a project on the Mokelume River in Amador County, Cal.; for the West Virginia Power Company of Charleston, project on New River, 5 miles above Hinton, involving the erection of a dam 140 ft. high; for the Consolidated Gold Mines-Alaska, a Spokane company, whose project is on Archangel Creek near Wasilla, and for the Pigeon River Lumber Company of Wisconsin Rapids, Wis. The last-named permit was granted with the understanding that no license will be issued until the project has been approved by the authorities of the Dominion of Canada and by the International Joint Commission.

The permit of the Alaskan Development & Mineral Company was extended for one year, as was a permit granted to the town of Petersburg, Alaska, and a permit granted to the Pacific Power & Light Company of Portland, the last-named covering a project at the reclamation site on the Deschutes River in Oregon.

Merger of Kansas and Nebraska Companies Looked For

Purchase of the United Light & Power Company system by the Continental Gas & Electric Corporation and the transformation of the two into one of the most extensive utility systems in the Middle West looms as the result of the negotiation of a contract option by officials of the two companies last week. Consummation of the deal depends on the findings of the Continental's engineers and accountants.

The United system serves 150 towns and cities in Kansas and southern Nebraska and includes eighteen generating plants, several gas plants, ice plants and about 22 miles of electric interurban railroad. The Continental serves 175 towns and cities in Nebraska, Iowa, Missouri and Canada and has an extensive system of steam and hydro-electric generating plants and of transmission lines.

The two systems are now within 15 miles of each other at several points. If the purchase is completed, transmission lines will be constructed at these points, connecting the two companies' holdings into one great four-state electric system.

Electric Lines Club Discussion on Bare Wire

A general discussion of the possibilities of doing away with weatherproof line wire on primary circuits was the feature of the regular meeting of the Electric Lines Club at East Providence, R. I., Oct. 25, R. S. Hale presiding. The article by S. C. Lindsay, "Why Use Weatherproof Line Wire?" in the ELECTRICAL WORLD for Sept. 22, page 609, served as a text. No final decision was reached at the meeting, but it was the general opinion that new construction with ample spacing between conductors offers the most attractive field for the present application of bare wire; that weatherproof insulation offers some protection against short circuits by swinging contact, and that in handling weatherproof wire linemen should take the same precautions as in handling bare conductors, utilizing to the full safety devices of proved value.

The Electric Lines Club was founded to provide a forum for the discussion of field problems in distribution system maintenance by line foremen and superintendents in eastern New England.

Brief News Notes

Northwestern Ohio Light Company to Move Headquarters.—The general offices of the Northwestern Ohio Light Company will be moved from Lima to Delphos soon in order to have the offices, central supply station and chief power plant in the same location.

Dothan (Ala.) Municipal Enterprise Enjoined.—A permanent injunction has been granted by the Alabama Circuit Court, on the application of five prominent citizens of Dothan, forbidding the city of Dothan, Caldwell & Company of Nashville, Tenn., and the Brooks-Calloway Construction Company of Atlanta to proceed with the erection of a hydro-electric plant on the Choctawhatchee River, about 20 miles from Dothan, for which the voters of the city granted $750,000 in bonds in 1921. The court ruled that the sale of the bonds was illegal and that the letting of the contract was irregular.

Recent Achievements of Radio.—Among recently recorded achievements in radio transmission are the receipt in Melbourne, Australia, of remarkably strong signals from American amateur radio stations and the receipt on Santa Catalina Island, Cal., of a message direct from the McMillan Polar expedition, now ice-bound within 11 deg. of the North Pole. According to a press dispatch from Omaha, the Arctic explorers heard a church service from Council Bluffs, and a message from Capt. McMillan has been relayed from Prince Rupert, B. C., asking for more.

Charleston (S. C.) Electrical Show Scores Success.—The electrical show held under the auspices of the Electrical Contractors and Dealers' Association of Charleston, S. C., on Oct. 15-20, scored a success beyond the expectations of that body. About 12,500 persons visited the show, which was the first event of the kind ever held in Charleston. Valuable prizes were offered, and awards were made for attractive displays. The leading electrical manufacturing companies of the country were represented by exhibits, and Charleston manufacturing, jobbing and contracting firms supported the show enthusiastically.

Washington-Idaho Company Fights Against Foreclosure.—A fight is being waged in the federal courts of the State of Washington in behalf of the Washington-Idaho Water, Light & Power Company, which seeks to prevent the American Power & Light Company of New York City from foreclosing mortgages totaling a million dollars on the property of the former company. The Washington-Idaho company, which operates in Clarkston and Winlock Wash., asserts its solvency, while th

plaintiff company—which last winter, the defendant says, purchased the 6 per cent and 8 per cent bonds of the Western utility and subsequently brought receivership proceedings in Massachusetts—claims that the Washington-Idaho company is in default.

Nebraska Power Company's Plans.—More than $3,000,000 is to be spent on improvements by the Nebraska Power Company of Omaha in the next eighteen months. The plans include a new central substation at Twentieth and Howard Streets, new "distribution headquarters," a substation at Twenty-third and Vinta Streets and various line extensions and other plant additions.

Equipping Boilers for Three Kinds of Fuel.—The Dallas (Tex.) Power & Light Company is going ahead with construction of the addition to its power plant in Dallas, which will cost in excess of $2,200,000, according to C. E. Calder, president of the company. The 15,000-kw. turbo-generator with the auxiliary equipment represents an outlay of $700,000. The boilers, four in number, are being equipped to burn coal, crude oil or gas, and the fuel that is the cheapest at the time will be used, Mr. Calder said. The cost of installing the boilers is $675,000. It is estimated by officials of the company that the new plant will be adequate to care for the needs of the city until 1926 or 1927.

Hagerstown Waiting for Decision on Municipal Plant or Central-Station Service.—Whether the people of Hagerstown, Md., shall float a bond issue of $300,000 for the erection of a new municipal electric plant or whether they shall purchase energy from the Potomac Public Service Company is soon to be determined by the Public Service Commission. The Potomac Public Service Company has made an offer by which it would furnish energy to Hagerstown cheaper than the city could manufacture it, but many of the taxpayers want a municipally owned plant regardless of the cheaper rate. As recounted in the ELECTRICAL WORLD of Aug. 4 (page 251), the Potomac company recently erected a modern switching station at Hagerstown to enable it to supply energy there from its new central station at Williamsport, Md.

Northern States to Control St. Anthony Falls Water Power.—The Northern States Power Company has purchased the Pillsbury interest in the St. Anthony Falls development at Minneapolis. In addition to the intrinsic value of this water power, it is a particularly important link in the Northern States Power Company's chain since it is near its load center. St. Anthony Falls is one of the most valuable hydro-electric sites in Minnesota, having a drop of 65 ft. and a capacity of 60,000 hp. Power now being developed at the falls furnishes energy for operation of the Pillsbury flour mills, which have a connected load of 32,000 hp., and the Minneapolis Street Railway system, with a connected load of 22,000 hp. The rest of the power generated at the falls has hitherto been sold wholesale to the Northern States Power Company.

Wenatchee Line Goes Into Service.—The Wenatchee transmission line between the White River power station of the Puget Sound Power & Light Company and the Columbia River Valley, a total length of 120 miles, was placed in service on Oct. 14. The construction of this line was begun in July last year, and the first 100 miles was placed in service in May this year. Since then the White River plant has been enlarged and new transformers installed. The company has recently begun the construction of two 110-kv. outdoor substations at Cle Elum and Wenatchee, Wash., which will complete the entire high-tension distribution system in connection with the Wenatchee line.

Kickapoo River Project.—Another hydro-electric project will be developed and placed in operation in Wisconsin to cost at least a million dollars if the Wisconsin Railroad Commission approves the application of the Kickapoo River Power Company calling for the construction of a dam with a drop of 30 ft. across the Kickapoo River near Wauzeka, as well as a new power plant. The project is conceived primarily as a summer resort venture because the back water accumulated will form the only lake in that part of the state, with a total length of 10 miles and nearly a mile wide, but the plant when completed will develop 1,700 hp., and transmission lines will be erected, substations constructed and interconnections made with the hydro-electric plants at Gay's Mills, Soldiers' Grove, Readstown, Viola and La Farge, which are overloaded and have been forced to install auxiliary steam equipment.

Associations and Societies

Commercial National Section, N. E. L. A.—The general and executive committee sessions of this section's group meetings at Salt Lake City this month will be held on Nov. 22, not Nov. 21, as stated last week. They follow the bureau meetings on Nov. 21.

Electric Utility Men to Meet at Tulsa.—Nov. 15 will be the date of the second annual conference of the first district of the electric light and power division of the Oklahoma Utilities Association. The meeting will be held at Tulsa and will be representative of eastern and northeastern Oklahoma. S. J. Smallwood, president of the Hominy Ice Light & Power Company, is chairman and H. N. Bates, district manager of the Public Service Company of Tulsa, is secretary of the first district organization. Leading representatives of the industry in the state will take part.

Cincinnati Electric Club Reorganized.—At a reorganization meeting of the Cincinnati Electric Club held on Oct. 24 these officers were elected: President, M. A. Curran; vice-presidents, Major Sam D. Heed, J. A. Brett and Charles Beltzhoover; secretary and treasurer, P. G. Wondersmith.

Central Division, C. E. A., to Meet on Nov. 20.—A two-day session of the Central Division of the National Electrical Credit Association will be held at the Hotel La Salle, Chicago, Nov. 20 and 21. Various trade group conferences will be held on the following subjects: Experiences with the E. C. A. service, effectiveness of "Model Letter A," use of E. C. A. forms, collection troubles and cures, trade conditions, creative credit management, proposals of improvements in system and service, credit work and credit letters. President Shepard will make a broad survey of credit and collection conditions with respect to the entire electrical industry and will endeavor to determine wherein the N. E. C. A. meets these conditions and where it falls short.

Coming Meetings of Electrical and Other Technical Societies

[A complete directory of electrical associations is published in the first issue of each volume. See July 7 issue, page 56, for latest list.]

American Society of Agricultural Engineers—Great Northern Hotel, Chicago, Nov. 8-10.

Associated Manufacturers of Electrical Supplies—Engineering Societies Building, New York, Nov. 8. Frederic Nicholas, 30 East 42d St., New York.

West Virginia Public Utilities Association—Hotel Kanawha, Charleston, W. Va., Nov. 9-10.

Electrical Supply Jobbers' Association—Hotel Statler, Buffalo, Nov. 12-15. Franklin Overbagh, 411 South Clinton Street, Chicago.

Electrical Manufacturers' Club — Hot Springs, Va., Nov. 14-18. F. L. Bishop, Hartford Faience Company, Hartford, Conn.

Arkansas Utilities Association—Pine Bluff, Nov. 15-16. R. I. Brown, Little Rock Railway & Electric Company, Little Rock.

Electric Power Club—French Lick Springs Hotel, French Lick, Ind., Nov. 19-22. S. N. Clarkson, B. F. Keith Bldg., Cleveland.

Southeastern Division, N. E. L. A.—Hillsboro Hotel, Tampa, Fla., Nov. 19-22. Charles A. Collier, Georgia Railway & Power Company, Atlanta, Ga.

Commercial National Section, N. E. L. A.—Group meetings, Salt Lake City, Nov. 21-22.

Electrical Credit Association, Central Division—Hotel LaSalle, Chicago, Nov. 20-21. F. P. Vose, 1341 Marquette Bldg., Chicago.

American Physical Society—Ryerson Physical Laboratory, Chicago, Nov. 30-Dec. 1. H. W. Webb, Columbia University, New York.

American Society of Mechanical Engineers—New York City, Dec. 3-6. C. W. Rice, 29 West 39th St., New York.

National Association of Railway and Utilities Commissioners—Miami, Fla., Dec. 4-7. J. B. Walker, New York Transit Commission, New York City.

American Engineering Council (F. A. E. S.)—Washington, Jan. 10-11. L. W. Wallace, 26 Jackson Place, Washington.

American Institute of Electrical Engineers—Midwinter convention, Philadelphia, Feb. 4-8. F. L. Hutchinson, 33 West 39th St., New York.

Commission Rulings

Company Ordered to Reimburse Customers for Equipment Necessitated by Change in Distribution System.—The New York Public Service Commission has directed the Plattsburg Gas & Electric Company to make certain payments to sixteen power users who incurred expense in making changes in their electrical installations when the company in 1921 made changes in its electrical distribution system. The company made adjustments with some of its customers, but declined to pay these sixteen claimants, alleging that it was not liable for the expenses which they had contracted.

Oregon Commission's Rules for Rural Electric Service.—As the outcome of a rehearing held at the request of certain electric utilities upon provisions of a commission order affecting rural extensions, and also upon certain provisions of an order affecting urban extension policy, the Oregon Public Service Commission consented to substitute for both orders a new set of extension rules embodying material modifications. The new rules prescribe that: (1) The operation percentage to be applied to the investment in extensions for which a customer pays should be confined to the actual cost of operation required by and pertaining to such kind of investment as controlling maintenance, superintendence and miscellaneous distribution expenses, but commercial utilization and other expenses not applicable to the operation of the portion of the extension covered by the excess investment should be excluded. (2) A total deficit percentage may be fixed without injustice to any utility charging customers for extension cost, in view of the fact that the extent of the development period is at best only an estimate of future growth. (3) A rule requiring a rural customer to pay only the excess cost of the investment in an extension and to pay monthly, in addition to the regular tariff rate, as a rural charge, the accruing carrying charges thereof, any subsequent development resulting in a refund of a proper proportion of the excess cost with a corresponding reduction of the monthly rural charge, is reasonable and reflects the actual development when it occurs. (4) A common development period may be used in computing charges to rural and city consumers for the excess cost of extensions when such period is not in excess of twelve years, but where it is impossible to comply with such a requirement for a common development period, the average development periods for the urban district should not be greater than eight years and the correspondingly much longer time for the development of rural districts should be as short a period as the prospective development thereof will permit.

Company Ordered to Restore Gas Service Discontinued Because of "Meter Jumping."—The Wisconsin Gas & Electric Company has been ordered by the Wisconsin Railroad Commission to restore gas service in a case where the meter was removed because it was found that a "by-pass" had been put in which prevented the meter from registering more than a part of the gas that passed through it. The company wished to make the payment by the customer of an estimated bill for gas not registered a condition precedent to restoration of service, but this the commission refused to permit, inasmuch as the customer and his family protested their entire ignorance of the existence of the "by-pass." The commission, saying that it was not the proper tribunal to decide whether or not a penal statute had been violated and that the consumer must be presumed innocent unless a proper court declared otherwise, said that to insist on the payment of the bill would be to presuppose guilt. The company was, however, authorized to collect from the customer the cost of disconnecting and reconnecting the meter.

What Constitutes Equitable Schedules?—Bills of electrical customers showing a large percentage variation in increase per kilowatt-hour of energy consumed under a new schedule are not conclusive evidence that the schedules are improperly constructed, according to a decision of the Board of Public Utility Commissioners of New Jersey in passing upon a complaint made by Louis Shapiro against the Consolidated Gas Company of New Jersey, which does an electrieal business in Long Branch and other places. All costs of an electrical company are not accrued in strict relation to the number of kilowatt-hours consumed by the customers, but costs of service fall into three general classes —capacity-of-demand costs, customer costs and energy consumed. The board said: "It is apparent, therefore, that a very large portion of the charge to each customer will have no direct relation to the kilowatt-hours of energy consumed and that the fact that the cost per kilowatt-hour has varied so greatly among the different complainants has no conclusive evidential value. An illustration of this may be given by the customer charge of $1 per month made to commercial regular customers. If such a customer used 1 kw.-hr. of energy, the customer cost of $1 would increase by $1 the other kilowatt-hour costs of energy consumed. If he used 5 kw.-hr. per month, it would add but 20 cents per kilowatt-hour; if he used 50 kw.hr., it would add but 2 cents per kilowatt-hour, and if he used 100 kw.-hr. per month, it would add but 1 cent per kilowatt-hour. Short-time use of facilities requires larger costs per kilowatt-hour by reason of the lower base on which to distribute the fixed costs such as the customer costs above referred to." Schedules for residential and commercial electric lighting are not unusual and inequitable, the commission said, when based upon a variation of the Wright demand rate, in form similar to the block meter rate, but with the difference that the blocks are not determined by a fixed number of kilowatt-hours but by relating the customer's kilowatt-hours used to the customer's demand, making the blocks not energy or current blocks but load-factor blocks.

Recent Court Decisions

Excessive or Exorbitant Penalties Provided for Violation of Commission Orders Not Ground for Injunction.—That a violation of a rate-fixing order of the Louisiana Public Service Commission may involve an excessive or exorbitant penalty affords no ground for an injunction to restrain the enforcement of such order, according to a decision of the United States Court for the Western Division of Louisiana, in a suit brought against the commission by the receivers of the Texas & Pacific Railway Company, since the penalties are separable from the order of the commission, and the court is not required to pass judgment on the penalty provisions in advance of an attempt to enforce them. A preliminary injunction to enjoin the enforcement of a rate-fixing order of the commission may properly be denied where there is no conclusive proof offered to show that the rates provided are unreasonable or violative of either state or federal constitution. (200 Fed. 1008.)*

Only Arbitrary or Unreasonable Action Justifies Interference with Commission Decisions.—Declaring that only clearly arbitrary or unreasonable actions on the part of a state regulatory commission could justify the reversal or setting aside of its rulings by the courts, the Supreme Court of Louisiana declared, in Vicksburg, Shreveport & Pacific Railway Company vs. Railroad Commission: "In the case before us we see nothing arbitrary in the action of the commission, nor do we see therein anything so clearly unreasonable as to amount to arbitrary action. We do not think the constitution intended that all the details of operating a railroad should be justiciable in a court of law, and whoever appeals to the courts to set aside an order of the commission issued in good faith and after due hearing should come prepared, not to show by a mere preponderance of evidence that the commission may have erred, but even to show by a strong preponderance of evidence that the action of the commission is so clearly and grossly unreasonable as to be purely arbitrary." (96 So. 832.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men
Engaged in all Branches of the Electrical Industry

Sir John Snell, the Chairman of British Electricity Commission

Sir John Snell, chairman of Great Britain's Electricity Commission, was born at Saltash, Cornwall, Dec. 15, 1869. For nine years after his graduation from Kings College, London, he was engaged in electric light and power work, chiefly with Crompton & Company at the Kensington Court and Notting Hill power stations and at Stockholm, Sweden. Sir John was appointed borough electrical and tramways engineer of Sunderland in 1896, which post he relinquished in 1906 to engage in private practice as a consulting engineer at Westminster, London. In 1910 he amalgamated with and became a partner of Preece, Cardew, Snell & Rider, consulting engineers, London. Nine years later he accepted the position of electrical adviser to the Board of Trade and chief electricity commissioner (designate). One year later he was appointed chairman of the newly appointed Electricity Commission.

SIR JOHN SNELL

Sir John Snell is a past-president of the Institution of Electrical Engineers, a member of the council of the Institution of Civil Engineers, a past-president of the Incorporated Municipal Electrical Association, a past-member of the main committee, past-chairman of the sectional electrical committee of the British Engineering Standards Association, a fellow of the American Institute of Electrical Engineers, a fellow of the Geological Society and a member of many other British organizations. During the war he devoted considerable time to very important national war committees dealing with engineering matters in Great Britain. Besides numerous articles in the scientific and technical press, Sir John Snell has written a book on "Distribution of Electrical Energy" and one on "Power-House Design."

General Guy E. Tripp, chairman of the board of the Westinghouse Electric & Manufacturing Company, who left for Japan early in October, has been decorated by the Japanese government with the Second Degree Order of the Sacred Treasure, one of the highest honors which can be conferred on a civilian foreigner. General Tripp's visit to the Far East is in connection with reconstruction work in cities destroyed by the recent earthquake.

E. S. Hight, an electrical engineer well known in the field in Illinois, has been made general operating engineer of the Illinois Power & Light Corporation. For a number of years he was chief operating engineer of the Illinois Traction Company, with headquarters at Peoria, Ill. He will be responsible for the efficiency and operation of the various power plants of the company he has just joined and will finish construction of the Topeka (Kan.) power house, the transmission line from Topeka to Atchison and the construction work under way at the Venice (Ill.) power house. His headquarters will be Chicago.

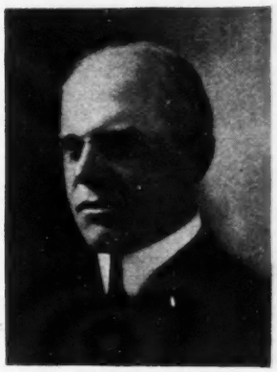
W. H. Ude has been appointed director of the newly organized public relations department of the Washington Water Power Company at Spokane, Wash. Mr. Ude has been in the transportation field for the past twenty-five years, having resigned as assistant general passenger agent of the Northern Pacific Railway to accept this new position. In addition to the public relations work he will have charge of the sale of company securities, a work which is already well under way, and beginning the first of the year a monthly magazine for employees will be issued by his department.

S. G. Gassoway became the assistant manager of the commercial department of the Oklahoma Gas & Electric Company on Nov. 1, according to an announcement of J. F. Owens, vice-president and general manager. Mr. Gassoway has been a pioneer in introducing electricity into the oil fields. Following his graduation from the University of California in 1904, he served with the General Electric Company at Schenectady, in the testing department and as construction engineer. From 1909 to the present time he has been identified with the oil industry. Mr. Gassoway is credited with installation of the first modern electric plant for oil-field drilling in California and is largely responsible for the development of the two-speed oil well and drilling motors which followed.

Dana R. Bullen Receives Promotion

At a meeting of the executive committee of the General Electric Company held Oct. 26 Dana R. Bullen was appointed assistant vice-president on the staff of the vice-president in charge of the sales of general apparatus and supplies.

Mr. Bullen will direct the relations of the company with all outside commercial, manufacturing and engineering associations and also individual membership in such organizations on the part of the company or its representatives, as well as undertake such additional executive duties assigned him as occasion requires.



D. R. BULLEN

Mr. Bullen first became identified with electrical interests in 1887, when he joined a construction gang at Webster, Mass., which was doing work for the Thomson-Houston Electric Company. He was soon transferred to Atlanta, and upon the opening of the Thomson-Houston office he became associated with its organization. He installed central-station equipment in Georgia, Florida and Alabama, and later took up sales work. In 1894 he organized the supply department at the Philadelphia office of the General Electric Company, into which the Thomson-Houston Company had been merged two years before. In 1900 he was made head of the supply department of the Boston office, and in 1904 was transferred to the general office at Schenectady, where he acted as assistant to J. R. Lovejoy, who at that time was manager of the railway, lighting and supply departments. Subsequently he was made assistant manager of the supply department and later manager, which position he occupied at the time of his recent promotion.

William Ungrodt, formerly connected with the Interstate Power Company at Cresco, Iowa, has recently been appointed to the staff of electrical service inspectors of the Wisconsin Railroad Commission. Mr. Ungrodt was previously associated for many years with

the Medford (Wis.) Light & Heating Company, whose service he left to go to Cresco.

W. W. Nichols, assistant to the president of the Allis-Chalmers Manufacturing Company, was elected president of the American Manufacturers' Export Association at the convention held Oct. 24-26 in the Waldorf-Astoria Hotel, New York City.

J. R. Lovejoy, a vice-president and director of the General Electric Company, who sailed from Vancouver, B. C., for Japan soon after the catastrophe, to assist in relief and reconstruction, will remain in that country for some time to promote rehabilitation, particularly of electrical projects. Mr. Lovejoy has for many years been interested in the foreign activities of the General Electric Company.

William F. Abely has been appointed credit manager of the Western Electric Company, Inc., Boston. Mr. Abely's service with the company covers about fifteen years, the past three of which have been spent as assistant manager in the New England territory. For ten years he was sales manager of the company with headquarters at Boston. He is one of the best known men in Eastern electrical supply jobbing circles and has worked untiringly for the upbuilding of the electrical industry through co-operation between its several branches.

C. S. Taylor has been appointed deputy engineer-in-chief and manager of the Shanghai (China) Municipal Electricity Department, succeeding A. H. Blagden, who resigned after twenty-one years' service. Mr. Taylor joined the department in 1913 and at the time of his promotion to deputy was holding the position of power engineer. He is a member of the Institution of Electrical Engineers (British) and also of the American Institute of Electrical Engineers.

Otto M. Rau, power specialist of Philadelphia, has been appointed in a consulting capacity to the staff of the Giant Power Survey for Pennsylvania, begun at Governor Pinchot's instance. Mr. Rau is to be in the Philadelphia office and to have charge of studies of power requirements, stations and transmission lines. He has done considerable rate and valuation work for public utility companies. His early experience was with the engineering department of the Edison General Electric Company, New York, whence he was assigned as resident engineer for the electrification of the street railways in Milwaukee. Later he was appointed chief electrician and general superintendent of the lighting and power department of the Milwaukee Electric Railway & Light Company. At the close of the war he became affiliated with Day & Zimmermann and more recently with the Stotesbury-Mitten management of the Philadelphia Rapid Transit Company, making special studies and investigations on superpower development and on pulverized fuels.

Frank Caspar Wagner, for the last twenty-eight years a professor of engineering at Rose Polytechnic Institute, Terre Haute, Ind., and acting president since the resignation of Dr. Philip B. Woodworth last May, has been elected president of the school by the board of managers. Professor Wagner was born in Ann Arbor, Mich., Oct. 5, 1864. After completing a high school course he entered the University of Michigan, from which he was graduated at the age of nineteen with the degree of master of arts. He began the study of engineering in the last years of his course at the university and also received the degree of mechanical engineer. He was an assistant instructor in physics in the University of Michigan and later entered the employ of the Thomson-Houston Electric Company of Lynn, Mass. He was sent by that company in 1888 to Mexico City, where he had charge of the company's engineering work. In addition to engineering work in Mexico City, he erected a street-lighting plant which was operated by water power at Pueblo. He resigned from the Thomson-Houston company in 1889 and took up experimental and university work at Ann Arbor, going to Terre Haute in 1895, as associate professor of steam and electrical engineering. His work has commanded attention throughout the country and he has been called on frequently to give expert testimony on engineering subjects in federal courts. He is a member of the A. I. E. E. and other scientific and engineering societies.

Obituary

George H. Moseman, for the past twenty-five years New England sales agent for the Weston Electrical Instrument Company, Newark, N. J., with headquarters at Boston, died suddenly Oct. 28 at his home in Brighton. Mr. Moseman was born at Bridgeport, Conn., about seventy years ago.

John Grimmins, assistant electrical engineer Malden (Mass.) Electric Company, was accidentally killed on Oct. 24 at the Everett substation of the company during an inspection trip of the New England System Operators' Club. He had removed the cover of an oil-switch cell and apparently put his hand within striking distance of a 22,000-volt circuit. The scheduled meeting of the System Operators' Club was terminated at once as a result of this fatality.

Leonard Eugene Voyer, assistant sales manager of the Edison Lamp Works in San Francisco, died of pneumonia on Oct. 27. Mr. Voyer entered the students' training course of the Edison Lamp Works of the General Electric Company on Aug. 1, 1911, and was connected with the Harrison (N. J.) office of that concern until 1914, when he went to the San Francisco office. At the time of his death Mr. Voyer was, in addition to being assistant sales manager of the San Francisco office, the street-lighting specialist for the San Francisco territory. He was a member of the San Francisco Bay Cities chapter of the Illuminating Engineering Society and also of the San Francisco Electrical Development League.

William J. Lloyd, general superintendent of the West Lynn works of the General Electric Company, died suddenly at Swampscott, Mass., Oct. 28. He was born at Philadelphia in 1866 and in 1883 was graduated from Lehigh University with the degree of mechanical engineer. For a time he was employed by the Westinghouse Electric & Manufacturing Company and about twenty-five years ago joined the General Electric organization. For five years he was at Rugby, England, with the British Thomson-Houston Company and later was at the Pittsfield (Mass.) works of the American organization. About fifteen years ago he was sent to Australia to establish the General Electric Company's plant in that country, being transferred to Lynn about three years later. He was promoted to his late post two years ago.

R. J. Morrisson, general manager of the Poughkeepsie & Wappingers Falls Railway Company, Poughkeepsie, N. Y., was found dead in his apartment on Monday evening, Oct. 29. The autopsy performed showed he had been overcome by carbon monoxide. Mr. Morrison had been in the public utility business since 1914. At the age of 17 he was secretary to Charles S. Banghart and purchasing agent when Mr. Banghart was vice-president and manager of the Binghamton (N. Y.) Railway Company. This position he held until May, 1917, when he enlisted. After his return from France he became assistant manager of the Augusta-Aiken Railway & Electric Corporation at Augusta, Ga., which position he held until the fall of 1920, when he was promoted to be private secretary to Mr. Pardee, president of the J. G. White Management Corporation. In October, 1922, he was made manager of the Poughkeepsie & Wappingers Falls Railway Company.

William M. Eaton of Jackson, Mich., died recently after a few days' illness. Mr. Eaton entered the public utility field in 1887, when he was made superintendent of the Jackson Gas Light Company. In 1903 he went to Grand Rapids in the capacity of vice-president and general manager of the gas company, but one year later he was selected to fill the office of vice-president and general manager of the Rochester Railway & Light Company at Rochester, N. Y. In 1907 he became affiliated with Hodenpyl, Hardy & Company, in which connection he served as a member of the operating committee for the gas and electric properties of the Commonwealth Power, Railway & Light Company. On Jan. 1, 1914, he resigned and returned to Jackson, retiring from active business life. Mr. Eaton was an ardent advocate of the interconnected power system and he supported W. A. Foote in his efforts to utilize the water power available in the Au Sable and Muskegon Rivers.

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

High-Tension Standardization Paramount

Equipment Design Should Be a Manufacturers' Activity, Although Operators Can Advise Regarding Problems—Demand for Special Designs Expensive

By H. W. Young
President the Delta-Star Electric Company, Chicago

A SERIOUS situation has arisen in the high-tension equipment field which closely parallels that which formerly existed in the motor, turbo-generator and insulator fields. It is that too many central-station engineers are trying to design their own high-tension equipment or at least to specify the design that manufacturers shall develop. Some are directing more attention to this part of their work than they are to meeting operating problems by applying equipment already available. This is a stage through which other parts of the industry have passed with serious results. There was a period when engineers felt that they should write out specifications on practically all equipment used. Particularly was this so in the insulator field, where engineers would specify types of insulators according to individual ideas without a full knowledge of porcelain manufacture, and the porcelain manufacturers were, therefore, obliged to make a great variety of designs, many of which were failures for which the porcelain manufacturers were unjustly blamed.

However, as the manufacturers' business grew, the burden of these special designs was recognized, and they developed their own designs, declining to make freak combinations. The result is that insulator designs are now condensed to a few standards and the quality has been greatly improved.

A similar situation exists today in the high-tension equipment field. It is decidedly worse than it was five years ago, and although undoubtedly this condition will subside, as it has in other industries, there are many reasons why engineers should leave the specification of designs to the manufacturer. Among these reasons, for instance, if an operating engineer insists upon a special equipment he will very materially lengthen his delivery time, increase the cost of manufacture and, lastly, place a serious burden upon his system should hurried replacement be necessary. Few men care deliberately to design and lay out the specifications of an automobile when there are so many types for sale on the market now. This should be equally true in the high-tension industry, where there are enough manufacturers to meet all requirements necessary.

H. W. Young

Let the manufacturer worry about the design feature. That is his job. Of course, he is always open to suggestions which will enable him to meet operating problems more effectively, but a keen-minded public utility man now does not design turbines or motors. Then why should he deliberately specify special high-tension equipment? This industry has been in operation long enough to shake down to certain fundamental principles which have become standardized. Take, for instance, the average air-break switch. In laying out a substation why should an engineer call for a breaking distance between contacts of 16 in. when a standard 15,000-volt air-break switch can be obtained with 15-in. breaking distance If he wants the greater breaking distance, why does he not select the next higher voltage above that at which the switch is to operate in order to be safe? The 15-in. breaking distance is one which manufacturers have determined from long experience is best for the conditions intended. It is a function of the ratio of the breakdown distance between contacts with respect to the breakdown distance of the insulators to the supports. All this has become standardized with the manufacturer, whereas the central-station engineer and design engineer merely think they want something special.

Costly Design Work

All the specifications of high-tension design are results of long and tedious experimental work. How can an average central-station designing room hope to compete with a manufacturer who is continually designing high-tension equipment and who uses many engineers continually kept at this specific work? The special design work required is not only costly but pregnant with trouble. A manufacturer is in a much better position to rectify troubles before production than is the utility. And since the major problem of the utility is continuous operation, any outage due to special equipment has a decidedly annoying effect upon public relations in that community.

Since manufacturers have established a standard equipment which is adapted to meet all operating conditions, why should not the central-station designing men co-operate with these manufacturers and use their equipment? Results from such standardization will follow the same economic laws as have appeared in

the turbine and motor fields. In other words, prices will become lower, the deliveries will become more prompt, and the replacement required by additions will be decidedly facilitated. It is time for central-station designers to "quit playing with toys" in the high-tension field. They should use the service offered by the manufacturers.

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

THERE has been no marked change in the condition of the electrical market this week. The only conspicuous movement in commodities was that affecting wire, which has seen a general reduction in the Chicago district affecting practically the entire range, with steady conditions on the Eastern coast. The volume of business in New England was good, with larger stocks in evidence and active buying of poles and pole-line hardware by the central stations.

Buying in New York was conservative but solid. Small motors are selling actively, particularly in the textile industry, all through the Eastern coast. Poles have been coming in in considerable quantities. In the Southeast range sales are growing materially, and there is much activity in radio, with a decided trend toward the higher-priced sets.

Business has been generally good in Chicago and on through to the Pacific Coast, where collections are improved. The appliance market there showed a strengthening influence. Japanese orders for lumber have stimulated the situation, and direct orders from Japan for line materials have made their appearance.

Nothing Definite Yet as to Japanese Purchases

OFFICIALS of the Japanese government as yet have not definitely decided upon a plan for making electrical and other construction material purchases in connection with the rehabilitation of the earthquake area. The Capital Restoration Board is working out such a plan at the present time, but its recommendations will have to be passed upon by the Diet, which is to convene about Nov. 10, and until that time nothing definite will be made public.

At first it was proposed to make all purchases through a centralized agency, but later developments indicate that only such materials as will be required in bulk will be so handled, leaving the remainder of the purchasing to private individuals. As a matter of fact, purchases of generators, insulators, cables and wires are being made in that manner at the present time.

According to recent reports, the Japanese government has also placed large orders in the United States for iron and steel and lumber, and private firms have been making purchases in foreign markets in the usual way. Judging from this procedure, Japanese firms making electrical purchases here will probably follow the plan that is to their best interests. If they find that they can buy cheaper through government agencies than they can by dealing direct with foreign exporters, they will certainly use that method, all other considerations being equal. A good part of Japan's needs, however, such as electrical material entering into new buildings, street railways, transmission lines, etc., will be bought on government account, and without question will be purchased through the Restoration Board.

Satisfactory Improvement Seen in Wooden-Pole Deliveries

SATISFACTORY improvement in the deliveries of all kinds of wooden poles has been brought about during the last three weeks both because of improved transportation along the Pacific Northwestern railroads and because of greater available stocks in the woods, where cutting and butt treating have progressed greatly as a result of a slightly better labor supply during the last two months.

This situation is decidedly heartening when compared with the difficulties encountered by the pole interests last summer. Although the wooden-pole business then was on a sound basis regarding demand and labor, some troubles were experienced in forest fires and greatly reduced transportation facilities. Since that period demand likewise has improved with ready supplies, and there is no difficulty in securing enough flat cars for shipments from sources in Canada and the United States.

Wooden-pole manufacturers are of the opinion that the bulk of output is now proceeding to utilities in Ohio, Indiana, Illinois and Pennsylvania, the greater amounts to the first two named states, with a decided falling off in demand in the Pennsylvania territory during the last month. Last week marked a great flow of poles to the Atlantic seaboard states.

Pole agents believe that approximately 55 per cent of their business is being done in new line construction and 45 per cent for replacements and short extensions. Authorities in the field state that there is a gradual falling off in replacement orders which is due to the fact that the present butt-treated product is lasting from six to eight years longer because of more efficient methods arrived at during recent years.

Prices are apt to remain steady for at least another year, say the pole makers, and they add that only severe forest fires or extreme labor troubles could have any immediate effect on present quotations. No changes have been made in Western cedar prices since April 24 last. The last change in Northern cedar was on May 28, 1923. Both of these were advances and were made to keep pace with demands of labor.

Waterwheels at 30 per Cent of Production Capacity in 1921

WATERWHEELS were manufactured during 1921 at a rate only slightly greater than 30 per cent of the capacity of the industry. Had conditions been such as to make maximum output possible, these products would have been manufactured to the value of $630,603,513. Instead, the value of the output of the 296 plants engaged in this type of work was $199,498,575, or 31.6 per cent of the possible output.

These figures have just been made public by the Bureau of the Census. They were compiled as a result of recommendations by the Committee on Census Schedules, created at a conference of trade associations, which met in Washington in 1921 at the instance of the National Association of Manufacturers. Nathan B. Williams was chairman of the committee.

The percentage of possible output among all of the industries of the country was 56.8. This covers 194,194 establishments, with a combined value of products of $42,318,241,453. Had these plants worked at maximum capacity, they would have produced the sum of $74,123,930,736.

Conservative Buying for Present Needs Seen in New York

MANUFACTURERS in New York and New Jersey sections say that some new signs of improvement have appeared, but that there is no marked gain in recent electrical business other than in the appliance field. There is a conservative feeling in the market which jobbers think is due to purchases for only immediate needs by the contractors and central-station companies.

It is said that the present reluctance in buying is mostly due to the heavy commitments made in April and May of this year, when many requirements by the utilities and industrials were covered for months ahead, and some operations are being postponed because it is believed in some circles that advantages may be had by waiting. In spite of this hesitant market, retail buying is showing continued improvement, which is expected to have much sustaining influence on the wholesale market in the near future.

During the week wire showed some softness in price, and it was not until last Tuesday that this commodity recovered its balance at the present

levels. Small motors during the last few days have shown added strength in the textile manufacturing districts of the metropolitan area, which, in turn, has greatly helped the second-hand establishments. Large amounts of poles are coming into the Eastern territory for replacements and early winter extensions. Considerable interest is being shown in all classes of line material.

Power Curtailed by Drought in Southeast; Business Holds Up

THE unusually long spell of dry weather has resulted in power curtailment in certain sections of the Southeast, but as yet the situation has not reached serious proportions. The volume of business in electrical jobbing lines continues to hold up, and one of the largest jobbers reports that his October sales will exceed the total for any month in the past two years. The electric range business is being followed up closely and sales are increasing steadily.

The movement of radio equipment is going excellently, and the largest jobber in this particular line states that the orders are far in excess of the supply. Last year the greater portion of the sales was for equipment going into amateur sets, but this fall the growing tendency is toward complete sets, with the sets ranging from $250 to $350 proving the most popular. However, deliveries on these sets are very unsatisfactory.

New England Jobbers Report Diversified Orders

LEADING jobbers in the Boston district are handling an increased volume of business as compared with a year ago. Stocks in some establishments have accumulated considerably of late, although a shortage in higher-grade radio sets is beginning to be felt here and there.

Prices were unsteady on wire all last week, and the recent advance in cotton is expected by some distributors to result in firmer quotations. Central-station buying of pole-line hardware is above normal in view of the prolonged mild season.

Buying for jobbers' stocks is rather cautious at the moment, but appliance manufacturers are pushing production at top speed against the pre-holiday demand. Interest in textile-motor drives took on new life this week from displays at the International Textile Exposition in Boston.

Wire Drops a Bit in Chicago District

THE electrical trade in Chicago continues to enjoy excellent business, and unless something unforeseen happens October will be one of the best months of the year. Prices remain generally firm, with the exception of rubber-covered code wire. The slight drop in copper has influenced prices a little, and this, together with the price war which is going on in this district, has caused a decline in code wire prices. No. 0 and smaller were reduced 3 per cent, Nos. 2/0 and 3/0 4 per cent, No. 4/0 and 250,000-circ.mil 5 per cent, 300,000-circ.mil and larger 6 per cent. Lead-covered cable was very slightly reduced, in some cases a matter of 20 cents to 60 cents per 1,000 ft. Certain wire companies feel that now is the time to corral this business and have made the slight reduction to load up with as much business as possible.

Chicago building permits up to Oct. 26 were a shade under the $23,000,000 mark, as announced by the "citizens' committee to enforce the Landis award." The committee's announcement asserts that the total for the year to date on building construction amounts to $277,108,729, compared with $227,741,970 for the entire year of 1922.

September Electrical Exports Gained $687,216

TOTAL exports of electrical machinery, apparatus and appurtenances for September were $5,925,529, an increase of $687,216 over September, 1922, when the total amounted to $5,238,313. In August, 1923, total electrical exports amounted to $6,183,186. The accompanying figures are supplied by the Bureau of Foreign and Domestic Commerce.

The Metal Market

QUOTATIONS of copper during the week reached the lowest levels in more than two years, sinking down to 12.37½ cents, delivered, with reports that even this figure had been shaded. Second hands were offering the metal quite freely at all times at quotations below the regular market. At times there were indications of demoralization in the copper market. The price is now down to a point where it has become a serious matter with some of the smaller producers whether they can continue operating.

NEW YORK METAL MARKET PRICES

	Oct. 24, 1923 Cents per Pound	Oct. 31, 1923 Cents per Pound
Copper, electrolytic	13.00	12.50
Lead, Am.S.& R.price	6.85	6.75
Antimony	7.62½	8.27½
Nickel, ingot	27.00 to 32.00	27.00 to 32.00
Zinc, spot	6.35	6.67½
Tin, Straits	41.50	42.12
Aluminum, 98 to 99 per cent	26.00 to 27.00	25.00

As it is, domestic consumption has gained to an unusual extent, while the buying from abroad has been about unchanged from pre-war years, with the result that more copper is available now than can be disposed of. How long this will continue until curtailment is decided upon remains to be seen.

ELECTRICAL EXPORTS FOR SEPTEMBER, 1923, COMPARED WITH CORRESPONDING MONTH A YEAR AGO

	Value September 1922	Value September 1923
Mechanical-drive turbines	68,370	$8,745
Generators:		
Direct-current:		
Under 500 kw	59,272	51,341
500 kw. and over	102,417	25,109
Alternating-current:		
Under 2,000 kva	7,668	4,816
2,000 kva. and over	24,870	211,391
Accessories and parts for generators	30,680	98,784
Self-contained lighting outfits	48,339	18,354
Primary batteries	88,552	89,556
Storage batteries	142,387	172,743
Power transformers	521,381	286,126
Other transformers	58,764	52,549
Rectifiers, condensers, double-current and motor-generators, dynamotors, synchronous and other converters	119,157	88,346
Switchboard panels, except telephone	365,348	39,297
Switch and circuit breakers above 10 amp	131,359	127,910
Fuses and fuse blocks	15,812	24,485
Watt-hour and other measuring meters	24,270	48,304
Volt, watt and ampere meters and other recording, indicating and testing apparatus	66,915	58,106
Lightning arresters, choke coils, reactors and other protective devices	66,567	42,919
Motors under 1 hp	78,829	142,566
Stationary motors, 1 to 200 hp	188,390	348,318
Stationary motors over 200 hp	25,320	67,513
Railway motors	35,251	150,487
Railway locomotives	132,498	260,000
Mining and industrial locomotives	28,297	66,452
Other motors	12,847	19,577
Rheostats, controllers and other starting and controlling equipment	106,414	150,499
Accessories and parts for motors	112,015	168,963
Electric fans	59,537	58,886
Incandescent carbon-filament lamps	7,019	3,260
Incandescent metal-filament lamps	99,893	72,441
Other electric lamps	19,793	25,704
Flashlights	29,630	34,934
Searchlights and projectors	22,247	35,431
Motor-driven household devices	49,920	61,948
Domestic heating and cooking devices	56,748	82,379
Industrial electric furnaces and ovens	24,988	27,367
Therapeutic apparatus, X-ray machines, galvanic and faradic batteries, etc.	46,278	64,888
Radio and wireless apparatus	207,535	258,967
Telegraph apparatus	34,261	21,668
Magneto telephones	*	9,818
Other telephones	296,025	73,249
Magneto switchboards	*	232
Other telephone switchboards	*	29,960
Railway signals, switches and attachments	25,469	69,800
Bells, buzzers and annunciators	7,162	6,540
Spark plugs, magnetos and other ignition apparatus	96,984	210,450
Insulating material	90,048	77,635
Metal conduit, outlets and switch boxes	23,434	25,136
Sockets, receptacles and lighting switches	65,735	83,994
Other wiring supplies and fixtures	158,818	138,806
Other electrical apparatus	422,211	756,642
Globes and shades for lighting fixtures	37,495	34,630
Electrical glassware, except for lighting	18,278	16,629
Electrical porcelain	129,241	109,802
Electrical carbons, carbon brushes and electrodes	109,724	232,151
Insulated wire and cable (iron or steel)	25,403	73,324
Other manufactures of aluminum	63,411	75,232
Copper wire (bare)	161,493	97,962
Insulated copper wire and cable	187,544	232,408
Total	$5,238,313	$5,925,529

* Not separately stated prior to Jan. 1, 1923.

Activities of the Trade

Devoted to News of the
Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Acquires Turbine Business of Wellman-Seaver-Morgan

An arrangement has been effected between the Wellman-Seaver-Morgan Company of Cleveland and Akron, Ohio, and the Newport News Shipbuilding & Dry Dock Company of Newport News, Va., whereby the latter company has taken over the future hydraulic turbine business of the Wellman-Seaver-Morgan Company, including the patterns, drawings, data, patents, patent applications, developed and undeveloped inventions and complete records, the results of years of experience in the hydraulic turbine business. All these have been transferred to the Newport News Shipbuilding & Dry Dock Company.

The staff of the Newport News Shipbuilding & Dry Dock Company is experienced in the successful handling of large engineering projects of the most exacting requirements. With the reinforcement of its staff by the additional engineering talent acquired from the Wellman-Seaver-Morgan Company, it will be able to carry out any undertakings in the hydraulic turbine field.

Duncan Electric Appointments

The Duncan Electric Manufacturing Company of Lafayette, Ind., manufacturer of meters and distribution transformers, announces the appointment of two new district sales agents. Walter W. Gaskill, 141 Milk Street, Boston, has been appointed district sales agent for the New England territory, and A. F. Blecksmith of 534 Bryson Building, Los Angeles, has been appointed district sales agent in territory comprising California, Nevada and Arizona. E. H. Albrecht of 310 Lewis Building, Portland, Ore., continues as district sales agent in the Washington-Oregon territory, to which place he was appointed several months ago.

Exporters Demand World Parley

The American Manufacturers' Export Association on Oct. 26 brought its three-day annual convention to a close in New York City with the adoption of resolutions reiterating its demand for the calling of a world economic conference, with the expression of an opinion that a remission of foreign debt payments would not be detrimental to American export trade, provided it is proved that all concessions made are adequately offset and guarantees are provided to equal in value whatever may be conceded in meritorious cases; favoring a privately owned and privately operated American merchant marine; recommending improvement in harbor facilities, and an improvement in harbor laws here and abroad by mutual agreement. The electrical groups were well represented.

Anaconda Copper Wage Cut

The wage cut of 50 cents a day at the Anaconda Copper Mining Company's Butte mines and Anaconda and Great Falls reduction works, Anaconda, Mont., will affect 14,000 all-day employees and will take effect Nov. 1. The reduction brings the pay of miners back to $4.75, which is the scale before the raise was granted last March.

Under the cut the minimum scale for common labor at the Anaconda reduction works will be $4.25, while the crafts' scale, which varies according to various classifications of labor, will average $5.50.

Further Hearing on Habirshaw Cable Set for Nov. 9

At a hearing in the United States District Court in New York City on Oct. 25 Judge John C. Knox declined to pass on the reorganization committee's motion for a receiver's sale of the properties of the Habirshaw Electric Cable Company until all dissenting creditors and stockholders could be heard.

Following the argument, in which the counsel for the dissenting group charged that there was question as to the need of from $1,500,000 to $2,000,000 of additional capital, which under the plan would be raised by the issue of preferred stock, Judge Knox set Nov. 9 as the date for further hearing.

No objection was made by any of the many creditors and stockholders at the hearing to the proposed settlement of $379,000 cash of government claims against the company and subsidiaries, which originally amounted to $1,125,000. The claims grew out of war-time contracts, and against them were claims by the companies against the government amounting to about $500,000, making the net amount of the government's claims approximately $625,000, which has been reduced to the cash payment mentioned. Judge Knox approved of the settlement being made on this basis.

The operating profits of the Habirshaw Electric Cable Company and its affiliated companies for the nine months ended Sept. 30 exceeded $649,000, it was reported last week. Sales were over $8,000,000, and unfilled orders amounted to $1,298,000. Bookings received in the third quarter totaled $2,478,000.

Allis-Chalmers Third Quarter Profits $756,981

The Allis-Chalmers Manufacturing Company, Milwaukee, for the quarter ended Sept. 30, 1923, reports sales billed aggregating $6,865,443, against $5,479,925 in the same quarter last year.

Net profits for the quarter amounted to $756,981, equal, after preferred dividends, to $1.82 a share on the $25,770,750 capital common stock outstanding. In the second quarter of this year the company reported profits equal to $1.30 a share on the common stock and 62 cents a share on the common in the third quarter of 1922.

For the first nine months of the current year net profits of $1,854,089 are reported, which, after allowing for dividends on the preferred, is equal to $3.83 a share on the company's common stock, against 63 cents a share earned in the same period last year. The statement of earnings for the September quarter compares as follows:

	1923	1922
Sales billed	$6,685,443	$5,479,925
Net profits (after deduction of federal taxes)	756,981	450,415

On the basis of the company's quarterly reports, earnings for the nine months ended Sept. 30, 1923, compare as follows:

	1923	1922
Sales billed	$18,169,305	$14,930,390
Net profits (after deduction of federal taxes)	1,854,089	1,028,944

General Electric Outlook Good

M. F. Westover, secretary of the General Electric Company, says that the company's outlook is good and that he can see no slackening in business He reports that incoming orders are running at the rate of over $5,000,000 weekly.

Pettingell-Andrews Becomes Axcess Distributor

The Pettingell-Andrews Company, Boston, has become exclusive distributor in New England for the "Axcess" industrial lighting system, manufactured by Sampson & Allen, Lynn, Mass. These devices will be sold by both the electrical department and the automobile division of the company. Milton Riley will supervise these sales for the company.

Carney Appoints Dawson Brande Manager at Minneapolis

Announcement is made that Dawson Brande has been appointed general sales manager in charge of the Minneapolis creosoting plant of B. T. Carney & Company, producers of Western red-cedar poles, Minneapolis. During 1909 to 1915 Mr. Brande was employed by the Carney firm as inspector and buyer of cedar products at Spokane, and from 1915 to 1919 he was assistant manager at the office at Grinnell, Iowa.

Terms of Sale of Canadian G. E. Announced at Toronto

Following the announcement last week from New York that the directors of the General Electric Company had approved the proposal to purchase control of the Canadian General Electric Company, President A. E. Dyment of the Canadian company made public the terms of sale in Toronto on the following day.

Present holders of the common shares of the Canadian General Electric Company are to receive, in exchange for each fully paid $100 share, the sum of $62.50 in cash, New York funds, and one fully paid $50 share of an open issue of new preference stock of the Canadian company, bearing a fixed cumulative dividend of 7 per cent and having a fixed preferential claim to repayment of capital in event of a winding up of the company. It is further provided that the present preferred stock of the Canadian company be retired at a premium of 15 per cent.

In order to secure the funds necessary to complete the purchase, the American General Electric Company has agreed to purchase an equal par value of common stock now in the treasury of the Canadian company at a premium of 15 per cent. The outstanding preferred stock totals $2,000,000, and on the basis of $115 per share some $2,300,000 will have to be raised by the sale of common stock to the parent company.

Of the $18,000,000 common authorized $10,800,000 is paid up, the balance being in the treasury of the Canadian company. The carrying out of the proposed arrangement will bring the outstanding common stock up to $12,800,000.

The agreement also provides that the common stock of the Canadian company may be converted to the extent that the respective holders so elect into a $50 share of new preference stock and a $50 share of common stock for each $100 share of common now held. The offer will remain open for acceptance until Dec. 15. On the acceptance by a sufficient amount of stock, the directors of the Canadian General Electric Company will proceed to call the necessary meetings of shareholders to ratify and complete the transaction.

In a special letter to the shareholders President Dyment calls attention to some of the advantages to be derived by the Canadian concern by the closer relationship with the American company. "Such a community of ownership," he points out, "will result in a very much more intimate and effective co-operation between the two organizations and, in the opinion of the directors, is essential to the maintenance by the company of a foremost position in its field of activity. The experience of the two companies over a long period has indicated clearly the importance of bringing about such closer relationship, and efforts have been made in that direction on different occasions during the past ten years, but until now no plan has been devised which appeared practicable from the standpoint of both companies."

The carrying out of the proposed plan is contingent upon the acceptance of its provisions by a sufficient number of holders of common shares to enable the General Electric Company to secure a majority.

Mr. Dyment stated that the personnel of the staff management and directorate would remain as at present. This new connection with one of the largest and strongest companies in the world will tend to facilitate financing of plant and other extensions for the expansion of business.

Westinghouse $500,000 Contract

The Westinghouse Electric & Manufacturing Company has been awarded a contract for motor-generator sets by the Brooklyn Edison Company. The contract is valued at about $500,000.

Copper & Brass Body Has Largest Budget in Its History

The Copper & Brass Research Association has proposed expenditures in 1924 amounting to $557,572, which is the largest budget in the history of that organization. Of the total, $231,000 is to be spent on newspaper, trade-paper and magazine advertising. This calls for twenty insertions in 136 papers in 108 cities for twenty weeks from Feb. 15 to June 30.

The research work will consume about $30,000, and literature, publicity bulletins, pamphlets, etc., will cost $181,500. Other items in the budget are: Salaries, $54,760; traveling expenses, etc., $95,812.

L. B. Underwood & Company, Inc., Pittsburgh, recently organized, will act as manufacturers' agent and now are representing Durham & Company, the Cole Metal Box Company, the Nyelec Switchboard Company and the Auth Electric Specialties Company. The firm's address is 451 Frick Annex.

The Lyvewyre Manufacturing Company, Indianapolis, has leased property at 20 South Capital Avenue and will establish works for the manufacture of batteries and parts.

The Westinghouse Electric International Company announces the appointment of Benjamin Soby as assistant to the manager, promotion of sales department.

The Remy Electric Company, Anderson, Ind., has started the construction of a one-story addition, containing 12,500 sq.ft. of floor space, to cost $25,000.

The Colonial Insulator Company, 973 Grant Avenue, Akron, Ohio, is planning the erection of a one-story addition, 30 ft. x 150 ft.

The C. R. Electric & Machine Company, Boston, has leased space in the building at 169 Harrison Avenue for the establishment of a local works.

The Western Electric Company intends to manufacture loop cable in its Kearny (N. J.) works on a larger scale than previously planned and is placing contracts for additional machinery. The cable buildings will soon have a capacity for manufacturing 210,000,000 ft. of loop cable per week.

The Conlon Corporation, Cicero, Ill., manufacturer of the new "Incomparable Conlon," has announced the appointment of C. G. Flatt as Rocky Mountain representative, with headquarters in Denver. Mr. Flatt was formerly a salesman with the Western Electric Company, and more recently has been associated with Alex Hibbard, Inc., Denver.

The Electric Storage Battery Company, Philadelphia, will soon commence excavations for the first unit of its proposed branch plant at Chouteau and Vandeventer Avenues, St. Louis. It will be one-story, 130 ft. x 245 ft., and used as an assembling and distributing works. It will cost approximately $100,000.

Harry Ross & Company, Inc., recently incorporated with $20,000 capital, will engage in the manufacture of electrical appliances at 142 West Thirty-first Street, New York City.

H. G. Overbeck has resigned as assistant manager of the electrical department of the Mine & Smelter Supply Company at Denver to represent the Meadows Manufacturing Company in the Rockey Mountain territory. The "Meadowlark" washing machine is soon to be featured by the Meadows firm.

The Miller-Seldon Electric Company, 1259 West Park Place, Detroit, manufacturer of electrical apparatus, will take bids at an early date for the construction of a two-and-three-story addition to its plant, 60 ft. x 225 ft., at McGraw Avenue and Twelfth Street, estimated to cost about $75,000.

The Russ Elektroofen A. G., Cologne, Germany, has been established and financed by the banking houses of Saasen & Company, in Bonn, and Stenger & Hoffmann & Company, in Essen. The primary object of the enterprise is the exploitation of the electric furnace patents of Mr. Russ. The exploitation will cover both the manufacture and selling of furnaces, as well as the granting of licenses.

The Western Electric Company, will soon commence excavations for a new warehouse and distributing plant on Kostner Street, near Ogden Avenue, Cicero, Ill., to cost approximately $1,000,000.

The Reliance Electric Company, Chicago, has foundations in progress for the erection of its proposed two-story-and-basement plant addition at 1313 Moorman Street, estimated to cost $60,000.

The Cook Electric Company, 360-64 Jelliff Avenue, Newark, N. J., has filled plans and will commence the immediate erection of a new two-story addition to its electric equipment plant, estimated to cost about $50,000.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

Purchase is desired in Basse-Terre, Guadeloupe (No. 7,998), for a thirty-passenger electric auto bus and electric touring cars.

Purchase is desired in Algiers, Algeria (No. 8,008), for high-grade passenger cars, spark plugs and accessories.

An agency is desired in Brisbane, Australia (No. 8,003), for electric motors and generators, alternating current, 415 and 240 volts, 50 cycles; electric generators and motors, direct current, 220/240 and 440/480 volts, electric heating appliances, accumulators, etc., air compressors, fans and blowers and refrigerating machinery.

Purchase and agency is desired in Sydney, Australia (No. 8,000), for electrical supplies, including cooking and heating appliances, small wireless sets, lighting supplies and usual stock for electrical contracting supplies on a fairly large scale.

TENDERS FOR ELECTRICAL EQUIPMENT FOR MORWELL (AUSTRALIA) POWER SCHEME.—Tenders will be received by the State Electricity Commission of Victoria, Melbourne, Australia, until Dec. 15 (Specification No. 23/145), for four, only, 1,000-kva., single-phase transformers and spares; also until Jan. 3, 1924 (Specification No. 24/1), for aluminum steel-cored cable and accessories, and also until Jan. 19, 1924 (Specification 24/2), for transformers, switchgear and accessories for substation "B." For details see Searchlight Section.

PROPOSED ELECTRIC PLANT AT GUAYAQUIL, ECUADOR.—Plans have been prepared, according to *Commerce Reports*, for a municipal electric plant at Guayaquil, Ecuador, for which, it is expected, bids will be asked later.

NEW ELECTRIC PLANT FOR BLOEMFONTEIN, SOUTH AFRICA.—A proposal to build a new power station with a capacity of 7,000 hp., it is reported, is under consideration by the Corporation of Bloemfontein. The cost is estimated at £180,000.

New Apparatus and Publications

POWER PLANT INSTRUMENTS.—"Cambridge Instruments for the Power Plant" is the title of a booklet issued by the Cambridge & Paul Instrument Company of America, Inc., Ossining-on-Hudson, N. Y., in which it describes and illustrates the "Cambridge" instruments, including electrical CO_2 apparatus, thermometers, pyrometers, stator and rotor outfits, etc., for power plants.

BOILER TRIMMINGS.—Bulletin No. 500 issued by the Wright-Austin Company, 315 West Woodbridge Street, Detroit, covers the safety alarm water columns and boiler trimmings manufactured by the company.

ATTACHMENTS FOR ELECTRIC CLEANER.—The United Electric Company, Canton, Ohio, is distributing a folder calling attention to the new model attachments for use with either the model 4 or new model 5 of the "Ohio" electric cleaner.

OIL DRYING AND PURIFYING OUTFITS.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has developed a special type of oil drying and purifying outfits for use in central stations and industrial plants using transformers, oil circuit breakers, feeder voltage regulators, etc., to dehydrate and purify oil.

FLOOR SURFACER.—The Globe Manufacturing & Distributing Company, 319 West Chicago Avenue, Chicago, has brought out a new electrically driven "Lightning" floor-surfacing machine, which is equipped with a 1½-hp. motor.

NON-MAGNETIC CAST IRON.—Ferranti, Limited, Hollingwood, Lancashire, England, is distributing five leaflets covering its "non-magnetic" cast iron for use in connection with electrical machinery.

ELECTRIC VALVE GRINDER.—A new low-speed, light-weight electric valve grinder has been developed by the Black & Decker Manufacturing Company, Townson Heights, Baltimore.

LOCK-OUT SWITCH.—The Cutter Company, Philadelphia, is now manufacturing, to be sold as a separate device, the "I-T-E" synchronous actuated lock-out feature for use in connection with the "I-T-E" rotary starting and running switches and circuit breakers.

TRANSFORMERS.—The Pittsburgh Transformer Company, Pittsburgh, is distributing bulletin No. 2,026, entitled "Transportation of Pittsburgh Transformers over Sierra Madre Mountains in Mexico." Bulletin No. 2,027 issued by the company describes the installation and operation of some "Pittsburgh" 15,000-kva. polyphase transformers.

LIGHTING FIXTURE.—The Edwin F. Guth Company, 2615-25 Washington Avenue, St. Louis, has developed a new standardized lighting fixture, known as "Mazelite."

LIGHTING UNIT.—"Electric Daylight for Your Kitchen" is the title of a leaflet distributed by the F. W. Wakefield Brass Company, Vermilion, Ohio, covering the "Red Spot" daylight kitchen unit.

New Incorporations

THE UNION STAR (MO.) ELECTRIC COMPANY has been incorporated with a capital stock of $10,000 by L. E. Martin, O. L. Perkins and others.

THE WHITE CITY POWER & DEVELOPMENT COMPANY, Montrose, Col., has been incorporated with a capital stock of $250,000 by Felix Baranowski, E. L. Young and P. C. Wills.

THE ARTHUR (IND.) ELECTRIC LIGHT & POWER COMPANY has been chartered with a capital stock of $700 by T. C. Young, Lawrence W. Skinner, Joseph Cox and James Willis.

THE MARION (WIS.) LIGHT & POWER COMPANY has been organized with a capital stock of $25,000 to furnish electricity in Marion and nearby towns. The incorporators are: F. H. Josslyn, J. H. and E. B. Driessen.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BIDDEFORD, ME.—The Cumberland County Power & Light Company, Portland, is erecting a double-circuit, 60,000-volt steel-tower transmission line between the Bonny Eagle power station and Biddeford and Saco, with a view of doubling the power service in this section.

LIMERICK, ME.—The Western Maine Power Company is planning to build a new hydro-electric power station on the Little Ossipee River at South Limington.

MARLBORO, N. H.—The Keene Gas & Electric Company is building a hydro-electric power plant here, to cost about $300,000.

PORTSMOUTH, N. H.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Nov. 6 for 50,000 attachment plug terminals, for use at the local navy yard. (Schedule 1503.)

WEYMOUTH, MASS.—The Edison Electric Illuminating Company, Boston, plans to install coal and ash-handling machinery, and other equipment at its local electric plant, now under construction.

PAWTUCKET, R. I.—The Imperial Printing & Finishing Company plans to construct a power house at its local plant.

PUTNAM, CONN.—The Putnam Woolen Company plans to build a hydro-electric plant for service at its local mill. The textile plant will be equipped throughout for electrical operation.

Middle Atlantic States

MIDDLETOWN, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until Nov. 28 for construction, heating, sanitary and electric work of restoration of main building, laundry building, additional accommodation for chronic patients (north building and connecting corridor (east group); laundry equipment for laundry building, etc., at the Middletown (N. Y.) State Homeopthic Hospital. Sullivan W. Jones, Capitol, Albany, is state architect.

ROCHESTER, N. Y.—Electric power equipment will be installed in the proposed addition to be erected by the Rochester Refrigerating Company, to cost about $150,000.

SHUSHAN, N. Y.—Surveys have been made by the state for a dam to create a lake 7 miles long in Battenkill River, for regulating water in Hudson River and furnishing water for a hydro-electric development 1 mile north of here. H. L. Cooper, 101 Park Avenue, New York City, is engineer.

VISCHERS FERRY, N. Y.—Bids will be received by Edward S. Walsh, Commissioner of Canals and Waterways, Capitol, Albany, until Nov. 8 for constructing the superstructure of a power house, etc., at Vischers Ferry dam.

CLIFTON, N. J.—Bids will be received by the Passaic Valley Sewerage Commissioners, Chamber of Commerce Building, until Nov. 13 for three electrically operated centrifugal pumps, each with daily capacity of 6,500,000 gal., for the local Yantacaw station, including one engine-driven electric generating set, with switchboard.

KEASBEY, N. J.—The power house and factory of the Raritan Hollow Tile Company were recently destroyed by fire, causing a loss of about $100,000.

ALLENTOWN, PA.—Plans have been authorized for extensions in the ornamental lighting system on Tenth and Sixth Streets. Other additions will be made in the business section later.

CHELTENHAM, PA.—The power house and plant of the Rowland Shovel Company, Central Avenue, were recently damaged by fire, causing a loss of about $18,000.

LANCASTER, PA.—The Clay-Lancaster and Penn-Lancaster Electric companies, recently organized, are planning to install power plants and systems in various sections of Lancaster County. L. D. West and J. H. Bucher head the companies.

PHILADELPHIA, PA.—The National Biscuit Company plans extensions in its power-house and baking plant at Broad Street and Glenwood Avenue, including the installation of equipment.

PHILADELPHIA, PA.—Bids will be asked at once by the navy supply officer, U. S. Navy, for one high-frequency apparatus (M. and S. req. 36); also, for two indicating annunciating gages (N.S.A.F. req. 279).

PHILADELPHIA, PA.—A power house will be erected by Amos H. Hall & Son, 2915 North Second Street, at their proposed plant on Erie Avenue, near F Street, to cost about $100,000.

PITTSBURGH, PA.—Plans have been authorized for the installation of a new street-lighting system on Penn and Liberty Avenues from Eleventh to Sixteenth Street. Later the new system will be extended to Thirty-fourth Street.

ROBBINS, PA.—The West Penn Power Company will extend over the Youghiogheny River here, its transmission system consisting of six 132,000-volt lines, three 22,000-volt lines, ground wires, telephone lines, etc.

CHARLESTON, W. VA.—The Federal Power Commission has granted the application of the West Virginia Power Company, a subsidiary of the Virginian Power Company, to build a 140-ft. dam in New River, 5 miles above Hinton, W. Va. The cost of the project is estimated at about $10,000,000.

ROANOKE, VA.—The Roanoke Water Works Company contemplates the installation of electrically operated pumping machinery in connection with extensions and improvements in its plant.

North Central States

DETROIT, MICH.—Plans have been filed by the Detroit Aero Metals Company, 657 Lycaste Street, for building the initial unit of its plant, consisting of a building and power house, to cost about $75,000.

FLINT, MICH.—The City Council has authorized the hospital board to issue $65,000 in bonds for the construction of a new power house and laundry for the Hurley Hospital and the new nurses' home.

HIGHLAND PARK, MICH.—The Ford Motor Company contemplates the construction of a power house at its proposed lead-

producing plant in Washington County, Mo. The works will cost about $200,000.

LANSING, MICH.—Electric power equipment will be installed in the printing plant to be erected by the Franklin-Lansing Company, recently organized, to cost about $160,000.

COLUMBUS, OHIO. — Electric power equipment will be installed in the proposed ice-manufacturing plant No. 2 of the Grocers & Butchers' Ice Company at Oakland Park, to cost about $150,000.

LIMA, OHIO.—The Ohio Power Company plans to build a substation in the Rockhill section, to cost about $216,000.

MASSILLON, OHIO. — The Massillon Water Supply Company is planning extensions, including the drilling of several new wells, installation of a 2,000,000-gal. pump and laying transmission lines, at a cost of about $50,000.

NEW BURLINGTON, OHIO.—Work will soon begin on the construction of a new power house for the St. Francis School. Kunz & Beck, Carew Building, Cincinnati, are architects.

NORWOOD, OHIO. — Steps have been taken by the Norwood Retail Merchants' Association for the installation of an ornamental lighting system in the business section of the city.

TILTONVILLE, OHIO.—Electric power equipment will be installed in the proposed local plant of the New Jersey Zinc Company, 160 Front Street, New York, to cost about $250,000.

LOUISVILLE, KY.—A substantial increase in the appropriation for street improvements and lighting, including the installation of additional ornamental lamps, will be asked by the Board of Works in the budget for 1924.

MADISONVILLE, KY. — Electric power equipment will be installed by the Madisonville Ice & Laundry Company, in connection with the rebuilding of its local plant, recently destroyed by fire with loss of about $100,000.

NOBLESVILLE, IND.—The City Council has approved the petition of the Home Telephone Company to place its cables underground. Plans are under consideration to require all electric wires to be placed underground.

VALPARAISO, IND. — The Valparaiso Lighting Company has arranged for an increase in capital to $200,000, for proposed extensions.

CHICAGO, ILL.—Electric power equipment will be installed in the new plant to be erected at 715-23 Kedzie Avenue by the Operators' Piano Company, 16 South Peoria Street, to cost about $150,000. H. E. Gallup, 110 South Dearborn Street, is architect.

CHICAGO, ILL. — The Commonwealth Edison Company has filed plans for the construction of a generating plant at 3601 South Crawford Avenue, to cost about $900,000. Graham, Anderson, Probst & White, 80 East Jackson Boulevard, are architects.

CHICAGO, ILL. — The Public Service Company of Northern Illinois has acquired the Interurban Public Service Corporation, which furnishes electrical service in Roselle, Cloverdale, Itasca, Meachan, Bartlett, Ontario and other towns, from a central station at Roselle. The Public Service Company will supply electricity to these towns from its high-tension lines.

BARRON, WIS.—Plans have been completed by the Electric Light and Power Commission for the erection of a high-tension transmission line between the power station at the city dam and the new plant at the Taylor dam.

EAU CLAIRE, WIS.—The Dells Pulp & Paper Company has applied to the Wisconsin Railroad Commission for permission to build a hydro-electric plant including a dam on the Chippewa River, to cost about $1,000,000.

MADISON, WIS. — Surveys are being made by the Wisconsin Power, Light & Heat Company with a view of extending its transmission line to Silver Lake to furnish service there.

NEW HOLSTEIN, WIS.—The Municipal Electric Light and Power Commission has applied to the Wisconsin Railroad Commission for permission to extend its transmission line to Maryville to furnish electricity there.

WAUZEKA, WIS.—The Kickapoo River Power Company, recently incorporated, has applied to the Wisconsin Railroad Commission for permission to construct a dam across the Kickapoo River and a power plant near Wauzeka. The plans call for a development of 1,700 hp., to cost about $1,000,000. E. E. Dillon, consulting engineer, Madison, is interested in the company.

WOODMAN, WIS.—At a recent election the proposal to establish a municipal electric system was carried.

ALEXANDRIA, MINN. — Plans are in progress for extensions in the electric lighting system, for which bids will be asked in the near future. The Charles L. Pillsbury Company, 1200 Second Avenue, South, Minneapolis, is engineer.

BRONSON, MINN.—The Minnesota Electric Distributing Company is erecting a transmission line to furnish electric service at Bronson, Kennedy, Hallock, Halma, Greenbush, Karlstad and vicinity. Electricity will be secured from the plant of the Crookston (Minn.) Water Works, Power & Light Company.

MINNEAPOLIS, MINN.—Electric power equipment will be installed in the new plant to be erected by the Buzza Company, 16 South Eighth Street, at Lake Street and Colfax Avenue, to cost about $150,000. Magney & Tusler, Inc., 126 South Ninth Street, are architects.

OWATONNA, MINN.—A special election will be held Nov. 5 to vote on the proposal to issue $350,000 in bonds for a municipal electric plant.

ST. CLOUD, MINN.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Nov. 21 for one electric passenger elevator and one hand-power freight elevator for buildings at the United States Veterans' Hospital, St. Cloud.

ST. PAUL, MINN. — The Ford Motor Company plans to build a 10,000-hp. auxiliary steam-driven electric plant at its local automobile works, supplementing a hydro-electric generating plant of 18,000 hp. on the Mississippi River. Four generators of 4,500 hp. each and waterwheels will be installed. Stone & Webster, Inc., 147 Milk Street, Boston, is engineer.

BURLINGTON, IOWA.—Plans are under consideration for the installation of an ornamental lighting system on Jefferson Street.

ROCKWELL CITY, IOWA. — The local plant of the Iowa Light, Heat & Power Company was recently destroyed by fire, causing a loss of about $100,000. At present the city is without electrical service.

HOLLIDAY, MO.—Bonds to the amount of $6,000 have been voted for the erection of an electric transmission line from Holliday to Paris.

NORBORNE, MO.—Bonds to the amount of $33,428 have been voted to establish a municipal electric light plant. R. R. McBride, Kansas City, is engineer.

SPRINGFIELD, MO. — Electric power equipment will be installed in the proposed local plant to be erected by the Missouri Rubber Products Company, of which Laurence Schmitt, Colonial Hotel, is head, to cost about $350,000.

FARGO, N. D.—The plant of the Union Light, Heat & Power plant was recently damaged by fire.

GENOA, NEB.—Plans have been completed by the Nebraska Gas & Electric Company, Omaha, for a local hydro-electric power plant, to cost $750,000, to supply electricity in this district.

HUMPHREY, NEB. — The Continental Gas & Electric Corporation, Omaha, has acquired the plant and distributing system of the Humphrey Electric Light & Power Company. The former will install a substation and serve the town from its Norfolk-Fullerton high-tension line. The old 220-volt direct-current system will be rebuilt for 110 volt alternating current.

TEKAMAH, NEB.—The Nebraska Gas & Electric Company plans to erect a transmission line and furnish service here. When completed the municipal electric plant will be discontinued.

WEST POINT, NEB. — The Nebraska Gas & Electric Company plans to build a transmission line to West Point.

Southern States

PILOT MOUNTAIN, N. C.—The installation of a light and power system is under consideration, for which $20,000 in bonds have been issued.

RALEIGH, N. C.—The stockholders of the Carolina Power & Light Company have authorized an increase of capital stock of $3,500,000, part of the proceeds to be used for further extensions to its systems.

SANFORD, N. C.—The installation of electrically operated pumps in connection with waterworks extensions to cost about $55,000, is under consideration.

ATLANTA, GA.—Plans for the proposed Stone Mountain City resort and hotel include an electric plant. An electrically operated pumping plant will also be installed. The cost is estimated at $1,000,000. O. F. Whittle, Nashville, Tenn., heads the project.

WOODBURY, GA.—The Council is considering rebuilding the electric light plant, recently destroyed by fire, causing a loss of about $10,000.

TAMPA, FLA. — Electric power equipment will be installed in the proposed cold-storage plant to be erected by the Interstate Investment Company in connection with a group of buildings, to cost about $800,000. Lockwood, Greene & Company, Atlanta, Ga., are engineers.

KNOXVILLE, TENN.—Extensions contemplated in the municipal water system, to cost about $2,000,000, include the installation of electrically operated pumping machinery.

MEMPHIS, TENN.—The Memphis Power & Light Company plans extensions to its generating plant and transmission lines. A 20,000-kw. turbo-generator and auxiliary machinery will be installed. The cost is estimated at about $1,000,000.

BIRMINGHAM, ALA. — The Alabama Power Company has issued $6,000,000 in bonds, part of the proceds to be used in connection with three hydro-electric power plants now under construction.

NEWTON, ALA.—The Houston Power Company plans extensions, including the construction of a 50-ft. dam across the Choctawhatchee River and the installation of two electric generators of 1,500 kw. capacity each. The Southern Engineering Corporation, Albany, Ga., is engineer.

TEXARKANA, ARK. — The Texarkana Water Corporation plans to install electrically operated pumping machinery in connection with extensions and improvements, to cost about $300,000.

CROWLEY, LA.—Bids will be received by the Board of Aldermen until Nov. 16 for municipal improvements, including a fire-alarm system (Schedule G). Merrill Bernard, Crowley, is engineer in charge.

NEW IBERIA, LA.—The Council is considering issuing bonds for rebuilding the municipal light and power plant.

PONCHATOULA, LA.—Bids will be received by E. D. Parker, city clerk, until Nov. 20 for two electrically operated centrifugal pumps and auxiliary equipment for the municipal waterworks. Swanson-McGraw, Inc., United Fruit Building, New Orleans, is engineer.

BOKOSHE, OKLA.—The installation of a street-lighting system has been authorized by the voters. Electricity will be furnished by the Oklahoma (Okla.) Gas & Electric Company.

HOWE, OKLA.—The citizens have voted to install a street-lighting system. Electricity will be furnished by the Oklahoma (Okla.) Gas & Electric Company.

RINGWOOD, OKLA.—Plans are being prepared for the erection of a transmission line for municipal service, with substation and distributing system. The State Power Company, Enid, will be joint owner with the municipality. J. D. Bomford, Masonic Temple Building, Enid, is engineer.

BEAUMONT, TEX.—The Voth Hardwood Company, operated by the Kirby Lumber Company, Houston, contemplates building power houses at its proposed two new hardwood mills, to cost about $300,000.

EL PASO, TEX.—The Elephant Butte Irrigation District contemplates the construction of a hydro-electric plant about 20 miles south of the present development, with initial output of 20,000 hp., to cost about $3,000,000.

MERCEDES, TEX.—The Valley Electric & Ice Company has been granted a fifty-year franchise in Mercedes.

Pacific and Mountain States

PORT ANGELES, WASH.—The installation of electrically operated pumping machinery at the proposed waterworks, to cost about $500,000, is under consideration. The Burns & McDonnell Engineering Company, Interstate Building, Kansas City, Mo., is consulting engineer.

SOUTH CLE ELUM, WASH.—The construction of a local substation to cost about $100,000, is reported to be under consideration by the Puget Sound Power & Light Company, Seattle.

ANTIOCH, CAL.—The Paraffin Companies, Inc., 40 First Street, San Francisco, contemplates rebuilding its power house and plant, recently destroyed by fire, with loss of about $400,000.

GILROY, CAL.—The installation of electrically operated pumping machinery at the waterworks, in connection with extension to cost $87,000, is under consideration. Charles Sloan, Santa Fé Building, San Francisco, is engineer.

HEALDSBURG, CAL.—Extensions and improvements in the territory served by the California Telephone & Light Company, involving an expenditure of about $25,000, have been approved by the Pacific Gas & Electric Company.

LOS ANGELES, CAL.—Bids will be received by the County Supervisors until Nov. 19 for the installation of an ornamental lighting system in the Graham Lighting District.

NATIONAL CITY, CAL.—The Atchison, Topeka & Santa Fé Railway Company plans to build a power house at its proposed local creosoting works, to cost about $275,000. D. L. Murray is in charge.

OROVILLE, CAL.—Plans for the proposed power development of the Feather River Power Company, recently organized, include six power plants and five reservoirs on the middle fork of the Feather River and its tributaries, which will eventually develop 202,000 hp. and provide water to irrigate between 75,000 and 100,000 acres of land. The first power plant, which will be known as the Bean Creek power plant will be located 18 miles from Oroville and will have an output of 62,000 hp. Lars Jorgensen holds the permit for the initial development. Construction of the first power house will begin early in 1925.

SACRAMENTO, CAL.—Plans are being prepared for the installation of an ornamental lighting system on Thirty-seventh Street from J Street to the Folsom Boulevard. A similar system is contemplated on Thirty-seventh Street south of Y Street. Albert Given is city engineer.

SALINAS, CAL.—The Coast Valleys Gas & Electric Company contemplates extensions to its system in this section.

SAN FRANCISCO, CAL.—Thomas A. Clarke, 424 Chronicle Building, and associates have applied to the State Water Department for permission to build a hydro-electric power plant on the South Fork of the Merced River, Mariposa County, for service at the properties of the Little Wonder Mines Company.

SAN LEANDRO, CAL.—Electric power equipment will be installed at the proposed new canning plant of the H. G. Prince Company, to replace the works recently destroyed by fire with loss of about $100,000.

STOCKTON, CAL.—Work will soon be started on the construction of seven of the buildings, including a power house, of the College of the Pacific in Stockton.

SPARKS, NEV.—Plans are under consideration for the installation of an electric fire-alarm system, to cost about $15,000.

Canada

VANCOUVER, B. C.—The British Columbia Electric Railway Company has tentative plans for the construction of a hydro-electric power plant, with transmission system, to cost about $4,000,000.

VERNON, B. C.—The municipal electric plant was recently damaged by an explosion, causing a loss of between $30,000 and $40,000. S. H. Excell is manager.

VICTORIA, B. C.—The erection of a second transmission line from Jordan River to Victoria is under consideration by the British Columbia Electric Railway Company.

BLYTHE, ONT.—The bylaw providing for the installation of Hydro-Electric power has been approved by the ratepayers.

BRUSSELS, ONT.—The ratepayers have passed the bylaw providing for the installation of Hydro-Electric power.

CAP ROUGE, QUE.—The St. Regis Pulp & Paper Company, Quebec, plans to build a power plant at its proposed pulp and paper mill at Cap Rouge, to cost about $3,500,000.

LACHINE, QUE.—Plans are being prepared by the Montreal Light, Heat & Power Company for the construction of a 16,000-hp. power plant at Lachine, to cost about $2,000,000.

QUEBEC, QUE.—The Quebec Power Company has issued $3,540,000 in bonds, part of the proceeds to be used for further extensions to its hydro-electric plants, transmission lines and distribution systems.

RIVIERER DES PRAIRIES, QUE.—Work, it is reported, has started on the proposed local development of the Back River Power Company, 35 Common Street, Montreal. The company, it is understood, will soon call for bids on the remainder of the work.

Electrical Patents

Announced by U. S. Patent Office

(Issued Oct. 9, 1923)

1,470,433. BATTERY CONNECTION; A. Fretschel, Almena, Wis. App. filed Feb. 28, 1921. Terminal post.

1,470,451. TELEPHONE EXCHANGE SYSTEM; T. Korthäuer, Siemensstadt, Germany. App. filed Dec. 9, 1921. Interconnection construction for stations having different systems.

1,470,466. DUMB-WAITER SIGNAL; W. Misiak, New York, N. Y. App. filed Feb. 21, 1921. General signal for all floors combined with individual signal.

1,470,518. BATTERY SEPARATOR; H. A. Yarnell, Escondido, Cal. App. filed April 28, 1921. Plates arranged face to face and provided with transverse corrugations.

1,470,523. SWITCH FOR ELECTRIC IRONS; H. Benvie, Meriden, Conn. App. filed March 25, 1922. Circuit closed when handle is gripped.

1,470,577. REENFORCED PLATINUM ANODE FOR PRODUCTION OF PER-SALTS; O. Liebnecht, Frankfort-on-the-Main, Germany. App. filed Aug. 27, 1921. Platinum reinforced with metallic zinc.

1,470,582. AUTOMATIC RECLOSING CIRCUIT-BREAKER SYSTEM; O. C. Traver, Schenectady, N. Y. App. filed Dec. 20, 1921. Controlled by electron tube.

(Issued Oct. 16, 1923)

1,470,594. SECRET SIGNALING SYSTEM; D. E. Branson, Danville, Ind. App. filed Sept. 13, 1918. System of telegraphic communication.

1,470,611. TELEPHONE EXCHANGE SYSTEM; R. S. Bailey, Montclair, N. J. App. filed Oct. 15, 1919. Method of connecting automatic to manual exchange.

1,470,628. DEVICE FOR HIGH-FREQUENCY SIGNALING; M. Latour, Paris, France. App. filed July 17, 1920. High-frequency telephone system in which high-frequency alternator is used as current source.

1,470,632. EQUALIZING TRANSMISSION; W. H. Martin, New York, N. Y. App. filed April 21, 1921. For telephone systems.

1,470,664. AUTOMATIC TELEPHONE EXCHANGE SYSTEM; F. R. McBerty, Evanston, Ill. App. filed Nov. 12, 1903. Full automatic system.

1,470,681. REGULATOR SYSTEM; C. A. Boddie, Pittsburgh, and R. E. Cullings, Wilkinsburg, Pa. App. filed Aug. 10, 1918. By field control of generators.

1,470,682. VOLTAGE REGULATOR SYSTEM; C. A. Boddie, Pittsburgh, Pa. App. filed Nov. 9, 1918. Automatic regulator.

1,470,691. RECORDING DEVICE; C. H. Marshall, Jr., Wilmerding, Pa. App. filed Dec. 13, 1919. Electrically operated graphical record for Olson testing machines.

1,470,695. STRUCTURAL STEEL FRAME FOR DYNAMO-ELECTRIC MACHINES; C. B. Mills, East McKeesport, Pa. App. filed Nov. 16, 1918.

1,470,696. TELEVISION; A. McL. Nicolson, New York, N. Y. App. filed Dec. 7, 1917. Method of transmitting and receiving records or pictures.

1,470,725. SELECTIVELY OPERATED CIRCUIT-CONTROLLING DEVICE; F. M. Goddard, Brooklyn, N. Y. App. filed July 12, 1919. Step-by-step type.

1,470,730. ELECTRIC REGULATOR SYSTEM; F. C. Hanker, Wilkinsburg, Pa. App. filed June 25, 1920. Equalizing voltages of generator and feeder circuit before connecting generator to feeder circuit.

1,470,733. SOUND DETECTION; H. C. Hayes, New London, Conn. App. filed June 25, 1919. For use under water.

1,470,758. RHEOSTAT; G. M. Little, Pittsburgh, Pa. App. filed Nov. 29, 1920. Slide-contact type.

1,470,759. SYSTEM OF CONTROL; F. M. Parks, Murrysville, Pa. App. filed Dec. 21, 1920. For crane or hoist motors.

1,470,774. PORTABLE LAMP; W. J. Spence, Lynn, Mass. App. filed May 15, 1922. Desk or reading lamp.

1,470,781. ROLLED CONDENSER; P. Thomas, Edgewood Park, Pa. App. filed Oct. 3, 1917. Method of attaching leads to terminals.

1,470,786. DYNAMO-ELECTRIC MACHINE; H. H. Wait, Chicago, Ill. App. filed Aug. 22, 1917. Field construction for high-speed machines.

1,470,788. BALLAST TUBE; P. T. Weeks, Caldwell, N. J. App. filed July 2, 1921. Electrical resistance device for maintaining constant current.

1,470,834. ELECTRIC HEATER; A. E. Hasselbach, Detroit, Mich. App. filed Dec. 30, 1920. Heating water to produce steam for cooking.

1,470,855. CHANDELIER; G. Ludwig, Chicago, Ill. App. filed Aug. 5, 1921. Provides ready passage for wires through chandelier.

1,470,883. CATHODE FOR THE ELECTROLYTIC REFINING OF METALS; C. H. Schuh, Brooklyn, N. Y. App. filed Nov. 22, 1922. Applied particularly to copper refining.

1,470,899. ELECTRICAL WAFFLE IRON; C. F. Wells, San Francisco, Cal. App. filed March 3, 1922.

1,470,912. ELECTRIC SOLDERING IRON; J. F. Coehille, Paris, France. App. filed Feb. 21, 1922. Heated by inclosed electric arc.

1,470,915. DRY CELL; H. de Olaneta, New Haven, Conn. App. filed June 18, 1920. For flashlights.

1,470,917. BATTERY CABINET; H. C. Goss, Beach Haven, Conn. App. filed June 6, 1922. For radio B batteries.

1,470,933. TRIP LEVER FOR OSCILLATING MAGNETOS; A. Rosner, Springfield, Mass. App. filed Jan. 18, 1922.

1,470,939. SYNCHRONOUS DYNAMO-ELECTRIC MACHINE; H. Silo, Nisikasugai Gun, Japan. App. filed May 29, 1919. Acts as synchronous motor or converter.

1,470,948. AUTOMATIC ELECTRIC GENERATING SYSTEM; A. R. Van Horn, Philadelphia, Pa. App. filed May 7, 1919. Engine-driven generator set.

1,470,954. REPEATING METHOD AND SYSTEM; W. E. Beatty, Bayside, N. Y. App. filed Dec. 11, 1920. Two-way repeating system uses elements of "push-pull" type.

1,470,955. ELECTRICAL WAVE TRANSMISSION SYSTEM; W. E. Booth, New York, N. Y. App. filed Nov. 22, 1919. Radio transmitting and receiving system.

1,470,956. PLUG RECEPTACLE; C. H. Bissell, Syracuse, N. Y. App. filed June 21, 1918. For electric conduits.

1,470,964. LIGHTING FIXTURE; C. C. Dose, Seattle, Wash. App. filed Oct. 20, 1920. Dust-proof inclosed fixture.

1,470,965. TRANSMISSION SYSTEM; G. W. Elmen, Leonia, N. J. App. filed Aug. 2, 1918. Magnetic repeater for telephone systems.

1,470,982. REPEATER CIRCUITS; J. S. Jammer, New York, N. Y. App. filed Oct. 29, 1920. Two-way repeating systems.

1,470,984. SIGNALING CIRCUITS; E. D. Johnson, East Orange, N. J. App. filed Feb. 7, 1918. Relates to telephone repeaters.

1,470,985. SIGNALING SYSTEM; K. S. Johnson, Jersey City, N. J. App. filed Sept. 5, 1919. Circuit arrangements for signaling systems in which repeaters or amplifiers are employed.

1,470,986. MEANS AND METHOD FOR SIGNALING; K. S. Johnson, Jersey City, N. J. App. filed Sept. 5, 1919. Three-wire telephone system.

1,470,991. TELEPHONE EXCHANGE SYSTEM; A. E. Lundell, New York, N. Y. App. filed Sept. 8, 1920. Link circuit with which repeating coil is associated used for extending connections.

1,470,992. TELEPHONE-EXCHANGE SYSTEM; A. E. Lundell, New York, N. Y. App. filed Sept. 8, 1920. Automatic exchange system of large capacity.

1,470,993. HOLDER FOR MAGNETO CONTACTS; L. A. Loundagin, Crane, Ore. App. filed Dec. 19, 1919.

1,471,013. TRANSMITTING DEVICE; J. B. Speed, New York, N. Y. App. filed Nov. 19, 1919. Telephone transmitter responsive to certain frequencies only.

1,471,017. TELEPHONE-EXCHANGE SYSTEM; S. B. Williams, Jr., Brooklyn, N. Y. App. filed Nov. 25, 1919. Employs machine switching.

1,471,018. TELEPHONE-EXCHANGE SYSTEM; S. B. Williams, Jr., Brooklyn, N. Y. App. filed April 17, 1918. Type employing automatic switches for distributing calls from telephone lines to the connecting circuits of operators' positions.

1,471,058. PROCESS FOR THE MANUFACTURE OF ACETALDEHYDE OR ACETIC ACID; H. Plauson, Hamburg, Germany. App. filed Jan. 13, 1921. By passing acetylene through the pores of conductive porous electrode.

1,471,064. TROLLEY WHEEL; J. S. Roncati, Los Angeles, Cal. App. filed April 8, 1922. Means for preventing wheel from leaving wire.

1,471,067. DYNAMO-ELECTRIC MACHINE; H. K. Sandell, Chicago, Ill. App. filed Aug. 3, 1917. Rotary converter.

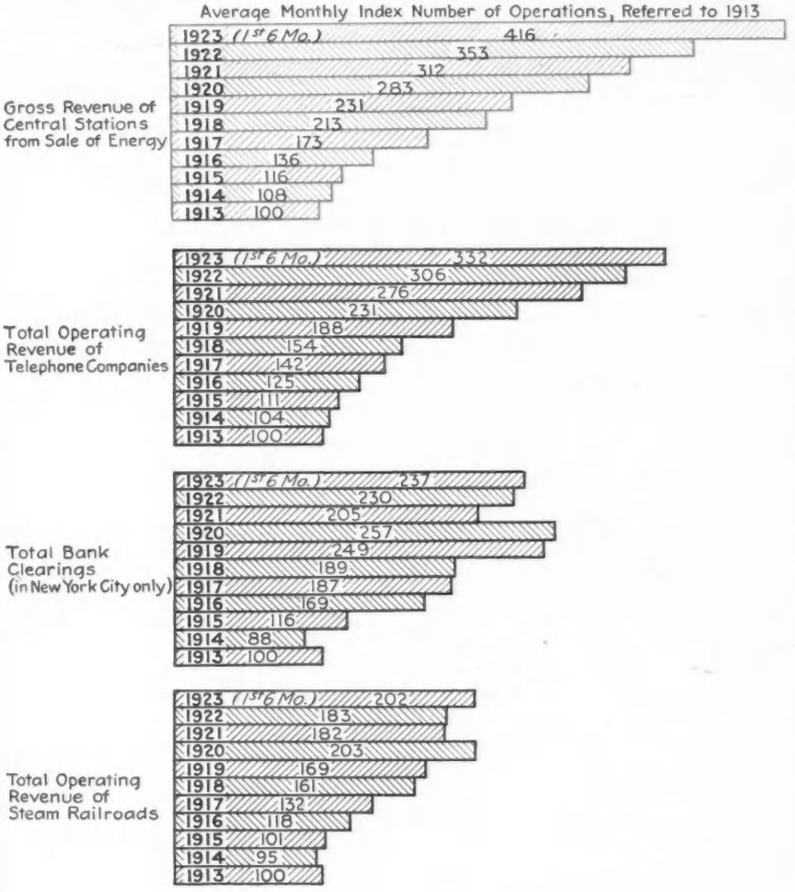
1,471,081. VIBRATING BUCKEY DIAPHRAGM FOR SCATTERED X-RAY RADIATION; H. F. Waite, New York, N. Y. App. filed Sept. 28, 1921. For producing clear-cut pictures.

1,471,093. SYSTEM OF ELECTRICAL DISTRIBUTION; W. L. Bliss, Niagara Falls, N. Y. App. filed June 3, 1916. Lighting of railway cars in which two storage batteries are used.

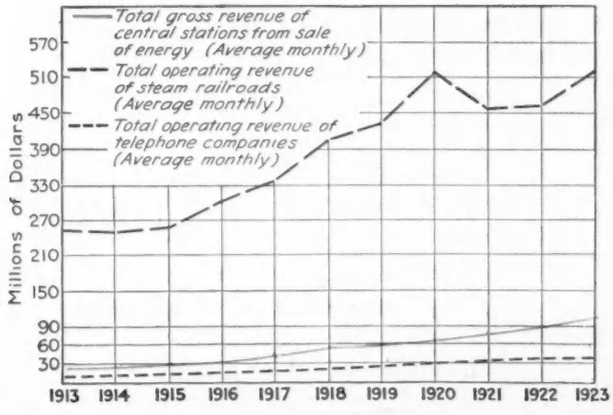
Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business

The Electric Light and Power Industry Has Led All Public Utilities in Relative Growth Since 1913



The Central-Station Yearly Gross Revenue Has Never Decreased Under Any Previous Year



Central-Station Revenue Quadruples in Ten Years

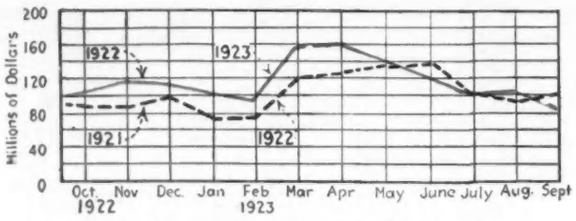
GROWTH and prosperity are largely matters of relativity. In studying the recent growth of industry reference is commonly made to conditions as they existed in 1913, the year immediately preceding the opening of the World War and subsequent abnormal conditions in American industry at large. In such a study the electric light and power industry stands out in bold relief in comparison with other public utilities and is one of the very few primary industries of the country which during the past ten years of chaotic economic conditions were able to report increased revenue year by year. In fact, the central station as a whole has never reported a decrease in yearly revenue since its establishment.

As is clearly shown in the accompanying diagram, the annual gross revenue of the central-station industry has more than quardrupled since 1913, the data indicating an almost uniformly accelerated annual growth during that ten-year period. Comparison with two other public utilities for which data are available—telephone companies and steam railways—accentuate this marvelous expansion of the central station. The operating revenue of the telephone companies, despite the nation-wide extension of telephone service, has only slightly more than tripled since 1913, but, like the central station, has always shown an annual increase in revenue. The steam railroads of the country have only just about been able to double their operating revenue during the ten-year period, and during 1921 and 1922 the yearly revenue showed a decrease under the previous year.

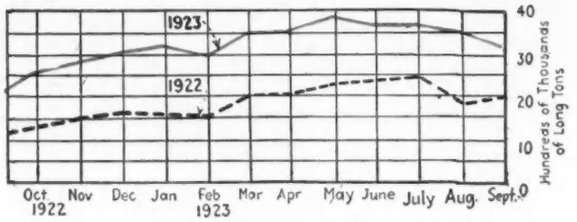
It is such outstanding facts as these that have placed central-station securities upon the highest plane as conservative investments and have made it possible for efficiently managed companies to borrow money at comparatively low rates of interest.

Most of the data for statistics in the ELECTRICAL WORLD are gathered by it from original sources. Privilege is freely given to readers of the ELECTRICAL WORLD to quote or use these statistics for any legitimate purpose. While there is no requirement that the source of data be given, yet it would help the ELECTRICAL WORLD in obtaining and compiling further basic information if those using these statistics would credit the ELECTRICAL WORLD.

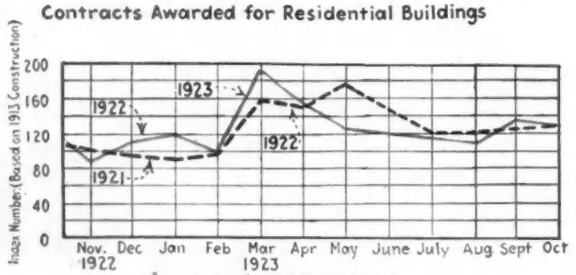
How the Primary Industries Are Trending



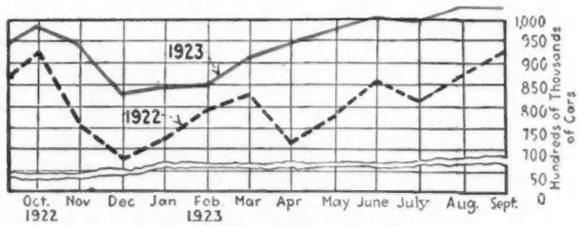
Contracts Awarded for Residential Buildings



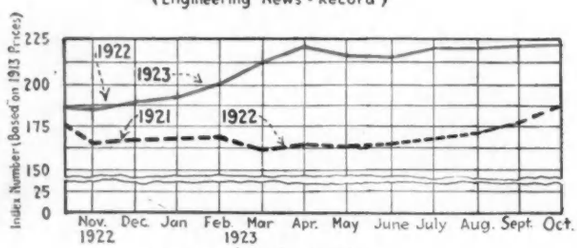
Pig-Iron Production



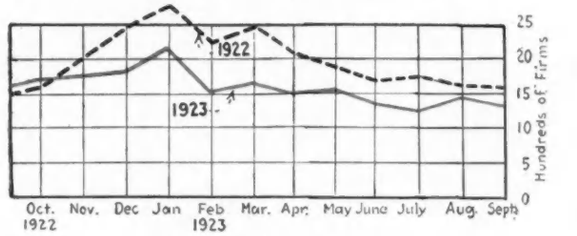
Construction Volume Index
(Engineering News-Record)



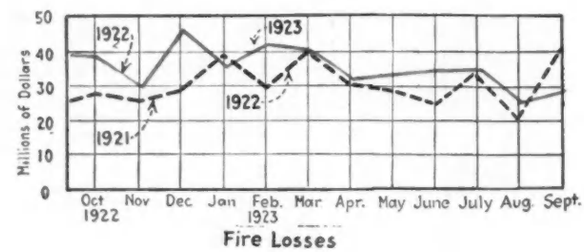
Total Average Weekly Freight-car Loading



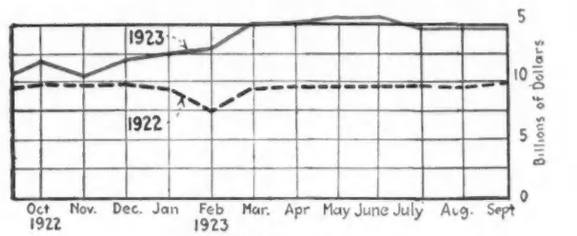
Construction Cost Index
(Engineering News-Record)



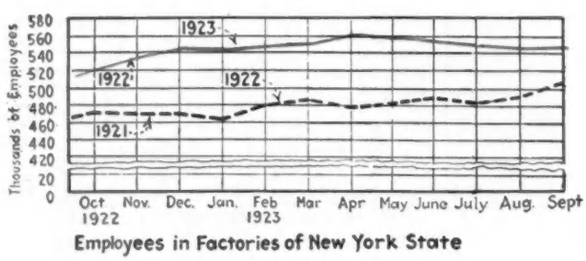
Business Failures



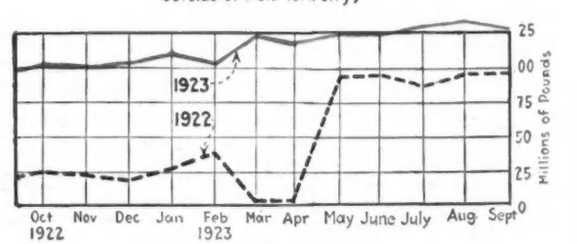
Fire Losses



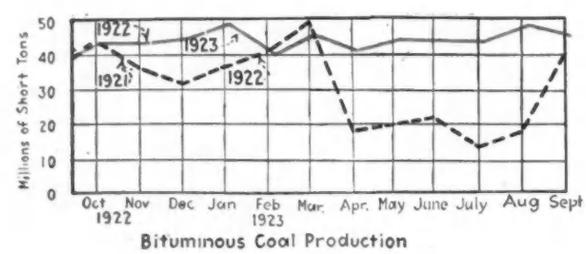
Bank Clearings
Outside of New York City)



Employees in Factories of New York State



Copper Production



Bituminous Coal Production

Fall Trade Will Be Large

PRELIMINARY data on industrial activity indicate that the volume of fall trade will be large. General conditions remain sound. Distribution, as indicated by the record car loadings, has been active, while stocks have not been reported as excessive. These conditions, taken in conjunction with the large purchasing power of consumers throughout the country at the present time, presage fall trade on a high plane.